MULTIPLE - MODULAR MANUAL

FOR GAS - FIRED BOILER
SERIES 8H / 8HE SIZES 5 THRU 10

AHRI CERTIFIED® www.ahridirectory.org

ASME H

⚠WARNING This manual must only be used by a qualified heating installer/service technician. BEFORE installing, read all instructions in this manual and all other information shipped with the boiler. Post all instructions and manuals near the boiler for reference by service personnel. Perform steps in the order given. Failure to comply could result in severe personal injury, death or substantial property damage.

BURNHAM® Commercial Boilers

www.burnhamcommercial.com

81416022R1 - 3/15

Price - $5.00

IMPORTANT INFORMATION -
READ and save these instructions for reference

HAZARD DEFINITIONS

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important information concerning the life of the product.

⚠DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

⚠WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

⚠CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury or property damage.

NOTICE

Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

NOTICE

THIS BOILER HAS A LIMITED WARRANTY, A COPY OF WHICH IS PRINTED ON THE BACK OF THIS MANUAL.

It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is complete. The warranty for this boiler is valid only if the boiler has been installed, maintained and operated in accordance with these instructions.

⚠DANGER

DO NOT store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

If you smell gas or fuel oil vapors, do not try to operate the burner/boiler system. Do not touch any electrical switch or use any phone in the building. Immediately call the gas or oil supplier from a remotely located phone.

Burner/boiler systems produce steam or hot water in a pressurized vessel by mixing extremely flammable gaseous, liquid or solid fuels with air to produce combustion and very hot products of combustion. Explosions, fires severe personal injury, death and/or property damage will result from improper, careless or inadequate installation, operation or maintenance of fuel-burning and boiler equipment.

⚠WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Failure to follow all instructions in the proper order can cause personal injury or death. Read and understand all instructions, including all those contained in component manufacturers manuals which are provided with the appliance before installing, starting-up, operating, maintaining or servicing this appliance. Keep this manual and literature in legible condition and posted near appliance for reference by owner and service technician.

These boilers require regular maintenance and service to operate safely. Follow the instructions contained in the Series 8H/8HE Installation, Operating and Service Instructions.

Installation, maintenance, and service must be performed only by an experienced, skilled and knowledgeable installer or service agency.

All heating systems should be designed by competent contractors and only persons knowledgeable in the layout and installation of hydronic heating systems should attempt installation of any boiler.

It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is completed.

Installation is not complete unless a pressure relief valve is installed into the specified tapping on the supply manifold located on top and at rear of appliance - See Section III, Paragraph 33, 'e' of the Series 8H/8HE Installation, Operating and Service Instructions for details.

These boilers are NOT suitable for installation on combustible flooring.

Do not tamper with or alter the boiler or controls. Retain your contractor or a competent serviceman to assure that the unit is properly adjusted and maintained.

Clean boilers at least once a year - preferably at the start of the heating season to remove soot and scale. The inside of the combustion chamber should also be cleaned and inspected at the same time.

Have Burner and Controls checked at least once a year or as may be necessitated. Do not operate unit with jumpered or absent controls or safety devices. Do not operate unit if any control, switch, component, or device has been subject to water.

⚠WARNING

Appliance materials of construction, products of combustion and the fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, aldehydes and/or other toxic or harmful substances which can cause death or serious injury and which are known to the state of California to cause cancer, birth defects and other reproductive harm. Always use proper safety clothing, respirators and equipment when servicing or working nearby the appliance.

These boilers contain very hot water under high pressure. Do not unscrew any pipe fittings nor attempt to disconnect any components of this boiler without positively assuring the water is cool and has no pressure. Always wear protective clothing and equipment when installing, starting up or servicing this boiler to prevent scald injuries. Do not rely on the pressure and temperature gauges to determine the temperature and pressure of the boiler. This boiler contains components which become very hot when the boiler is operating. Do not touch any components unless they are cool.

All appliances must be properly vented and connected to an approved vent system in good condition. Do not operate boilers with the absence of an approved vent system.

These boilers need fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air.

The interior of the venting and air intake systems must be inspected and cleaned before the start of the heating season and should be inspected periodically throughout the heating season for any obstructions. Clean and unobstructed venting and air intake systems are necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

These boilers are supplied with controls which may cause the boiler to shut down and not re-start without service. If damage due to frozen pipes is a possibility, the heating system should not be left unattended in cold weather; or appropriate safeguards and alarms should be installed on the heating system to prevent damage if the boiler is inoperative.

This boiler is designed to burn natural and/or LP gas only. Do not use gasoline, crankcase drainings, or any oil containing gasoline. Never burn garbage or paper in this boiler. Do not convert to any solid fuel (i.e. wood, coal). All flammable debris, rags, paper, wood scraps, etc., should be kept clear of the boiler at all times. Keep the boiler area clean and free of fire hazards.

Float type low water cutoff devices require annual inspection and maintenance. Refer to instructions in Section V, Paragraph 7 of the Series 8H/8HE Installation, Operating and Service Instructions for inspection and cleaning instructions.

NOTICE

All Series 8HE cast iron boilers are designed, built, marked and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, Heating Boilers. An ASME Data Label is factory applied to each 8HE jacket, which indicates the boiler Maximum Allowable working Pressure (MAWP). Each cast iron section is permanently marked with the MAWP listed on the boiler's ASME Data Label. The MAWP for all Series 8HE Boiler is 50 psi (Water Only).

It is common and acceptable practice to install these boilers in lower pressure systems, below the boiler MAWP. Therefore, in addition to Safety Relief Valves set for 50 psi, Burnham also offers Safety Relief Valves set for 30 psi (By Special Order Only).

Important Product Safety Information
Refractory Ceramic Fiber Product

⚠WARNING

The Repair Parts list designates parts that contain refractory ceramic fibers (RCF). RCF has been classified as a possible human carcinogen. When exposed to temperatures above 1805°F, such as during direct flame contact, RCF changes into crystalline silica, a known carcinogen. When disturbed as a result of servicing or repair, these substances become airborne and, if inhaled, may be hazardous to your health.

AVOID Breathing Fiber Particulates and Dust

Precautionary Measures:

Do not remove or replace RCF parts or attempt any service or repair work involving RCF without wearing the following protective gear:

1. A National Institute for Occupational Safety and Health (NIOSH) approved respirator
2. Long sleeved, loose fitting clothing
3. Gloves
4. Eye Protection

- Take steps to assure adequate ventilation.
- Wash all exposed body areas gently with soap and water after contact.
- Wash work clothes separately from other laundry and rinse washing machine after use to avoid contaminating other clothes.
- Discard used RCF components by sealing in an airtight plastic bag. RCF and crystalline silica are not classified as hazardous wastes in the United States and Canada.

First Aid Procedures:

- If contact with eyes: Flush with water for at least 15 minutes. Seek immediate medical attention if irritation persists.
- If contact with skin: Wash affected area gently with soap and water. Seek immediate medical attention if irritation persists.
- If breathing difficulty develops: Leave the area and move to a location with clean fresh air. Seek immediate medical attention if breathing difficulties persist.
- Ingestion: Do not induce vomiting. Drink plenty of water. Seek immediate medical attention.

LIST OF FIGURES

LIST OF FIGURES (continued)

⚠ CAUTION

**Series 8H/8HE Boilers are NOT suitable for direct installation on combustible flooring.
Refer to the 8H/8HE Installation, Operating and Service Instructions (Part Number 81416021) for Installation Instructions for Floor Shields that are available and required for combustible floor installations.**

SECTION 1.0 COMBUSTION, VENTILATION & VENT SYSTEMS

1.1 INTRODUCTION – The basic principles of combustion or burning of a gaseous fuel should be reviewed briefly in order for the reader to appreciate the necessity of: (1) providing adequate ventilation for replacement of air consumed during the combustion process and the replacement of air carried out with the products of combustion, and (2) providing a properly designed vent system that will effectively convey the gases produced during the burning process to the outside atmosphere along with any air diluting the flue gases.

1.2 COMBUSTION – In order for combustion or burning to take place three things are needed:

1) Fuel-in this case, natural gas or propane.
2) Oxygen-oxygen is obtained from the air which is approximately 20% oxygen and approximately 80% nitrogen. Nitrogen is inert and will not burn.
3) Heat-gas will not urn until its temperature is raised to its ignition point, approximately 1100-1200°F. A gas burning pilot (open flame) or electrical means (spark) is used for the initial ignition after which the flame itself provides the heat needed to sustain combustion.

If any of the three are taken away, combustion cannot take place.

Because the mixing of air and fuel is not 100% complete, more air than is actually needed called excess air must be supplied to the appliance in order for burning to be complete. This is shown in Figure 1-1.

If the supply of fresh air is inadequate or is not continually replenished as it is used up, carbon monoxide (CO) and Hydrogen (H^2) as well as the products of combustion shown in Fig. 1-1 may be produced. This is undesirable since carbon monoxide is toxic and some-times lethal even in small quantities.

In addition to the fresh air required for combustion, fresh air is also required to dilute the flue products so that the resultant flue gas temperature is reduced to what is considered a safe level. Thus, a total of 16 cu. Ft. of air may be required for each cu. ft. of gas burned, 12.5 cu. ft. for the combustion process and 3.5 cu. ft. for the dilution process.

1.3 VENTILATION – Fresh air requirements for the heating plant will vary with the space in which the plant is located as described and illustrated in succeeding paragraphs. Reference to free area of air inlets is made in the text since louvers, grilles, or screens are sometimes used at or in the inlet and these have a blocking effect. This must be taken into consideration in order to obtain proper quantities of fresh air. If the free areas of these devices are not known, it may be assumed that wood louvers will have 20-25% free area and metal louvers and grilles will have 60-75% free area.

For installation in boiler rooms with ventilation air provided from inside of building having adequate infiltration from outdoors, each opening shall have a free area of not less than one (1) square inch per 1000 Btuh of the total input rating of the heating plant and other fuel burning appliance in the boiler room. See Figure 1-2.

For installation in boiler rooms with ventilation air provided directly from outdoors, each opening shall have a free area of not less than one (1) square inch per 4000 Btuh of the total input rating of the heating unit and other fuel burning appliance in the boiler room. Each opening should be equipped with a screen covering whose mesh should not be less than ¼ inch and each opening should be constructed so that they cannot be closed. See Figure 1-3.

Normally, if the boiler is installed in an unconfined space, an adequate amount of ventilation air will be supplied by natural infiltration. If however, the unconfined space is of unusually tight construction, air from outdoors will be needed. A permanent opening or openings with a total free area of not less than one (1) square inch per 5000 Btuh of the total input rating of the heating plant and other fuel burning appliances in the unconfined space is necessary. If ducts (minimum rectangular area of 3 square inches) are used, they must be the same cross-sectional area as the free area of the opening to which they connect. Screening to cover the openings to the outside should not be smaller than ¼ inch mesh and each opening should be constructed so that they cannot be closed. See Figure 1-4.

⚠WARNING

Adequate combustion and ventilation air must be provided to assure proper combustion.

⚠ CAUTION

The importance of adequate and proper ventilation cannot be overemphasized. It must also be understood that venting and ventilation must always be considered together. They are both part of the same system and must balance each other.

If exhaust fans are utilized such as for make-up air, the make-up air should not be drawn from the same space that is the source of combustion air for the heating plant unless adequate provisions are made to supply additional outside air so that the space surrounding the heating unit is not under a negative pressures (less than outdoor pressure).

Blowers should not be used to forcibly provide ventilation unless controlled to a point where static pressure in the space in which the heating plant is located is equal to the outdoor pressure.

CAUTION (continued)

Excess pressure resulting from larger than necessary volumes of fresh air will cause excessive dilution of the flue products resulting in low flue gas temperatures. If lowered below the dew point, condensation of the moisture in the flue gases will occur and, if continued over an extended period of time, will corrode vents, drafthoods, heat exchangers, and burners.

There are certain elements known as halogens (fluorine, chlorine, bromide, iodine and astatine) which are utilized in many commercial products (refrigerants, solvents, spray can propellant, etc.). If these products must be used near the heating plant, extra precaution must be taken to obtain uncontaminated air from the outside, otherwise severe corrosion will occur in the boiler and vent system.

⚠WARNING

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

1.4 VENTING – As pointed out before, venting is the process of removing of the flue products. There are basically two types of venting: atmospheric (or gravity) and power venting. Further discussion will be limited to atmospheric vent systems since it is, by far, the most commonly used and the most applicable to the Series 8H/8HE modular boilers. The atmospheric system is composed of numerous parts and it is necessary to understand the function and operation of each part in order to properly design the system.

⚠WARNING

Do not alter boiler draft hood or place any obstruction or non-approved damper in the breeching or vent system. Flue gas spillage can occur. Unsafe boiler operation will occur.

1.4.1 DRAFTHOOD – The flue outlet of a heating appliance such as the Series 8H/8HE module cannot be connected directly to the vent system for the following reasons:

a) The amount of air drawn thru the combustion chamber would vary with the height of the vent pipe. Hence, there would be little or no chance of maintaining the same air flow rate thru the appliance for the variety of installation conditions which invariably are encountered.

b) There would be no way to compensate for variable wind conditions encountered at the terminal of the vent. If wind conditions created a negative pressure at the vent terminal, this negative pressure would tend to increase the flow thru the vent system – this phenomena is referred to as updraft. If the wind created a positive pressure at the terminal, the flow through the vent system would be retarded or reversed – this condition is referred to as downdraft.

c) There would be no avenue of escape for the flue gases in case the vent became blocked.

d) Flue gases, if undiluted, could reach temperatures which would create a potential fire hazard if the flue gases were to strike flammable surfaces.

To overcome all of the deficiencies outlined above, an AGA listed vertical to vertical type of drafthood is furnished with each Series 8H/8HE boiler, see insert of Fig. 1-5. The inlet opening of the drafthood is connected to the flue outlet of the boiler, and the exit or outlet opening of the drafthood is connected to the riser portion of the vent connector. The inlet and exit diameter and the stem height of the drafthood are a function of boiler size since they were determined only after extensive testing and after certification by the American Gas Association and by the Canadian Gas Association. Therefore, THE DRAFTHOOD MUST NOT BE ALTERED IN ANY MANNER.

1.4.2 VENT CONNECTOR – see Fig. 1-5. The vent connector is that portion of the vent system which connects the exit (outlet) of a drafthood of an individual appliance to the manifold vent (breeching) servicing two or more boilers. If there is a horizontal run in the vent connector, this horizontal run is known as a lateral. Since the vent connector may enter the bottom or the side of the manifold vent, the vent connector rise is the vertical distance from the drafthood outlet to the lowest level at which the connector enters the manifold. A slip joint or drawband, as illustrated in Fig. 1-5, will facilitate installation of connectors as well as replacement of parts in that portion of the system should it ever become necessary.

1.4.3 MANIFOLD AND COMMON VENTS – see Figs. 1-5, 1-6. A manifold vent or breeching is a horizontal extension of the vertical common vent. The common vent, which is sized to handle the total load when all modules are operating, can be of masonry construction, single-wall metal pipe, or type B Gas Vent Pipe – consult local codes. A UL Listed vent cap should be installed, if possible, at the exit of the common vent to assure full vent capacity and freedom from adverse wind effects.

Total vent height is the vertical distance between the exit of the common vent and the exit or outlet of the drafthood. Regardless of the calculated total vent height required for capacity, all vents must be correctly terminated a sufficient distance above the roof surface and away from nearby obstructions, see Figs. 1-5 and 1.6. This is to avoid adverse

wind effects or pressure areas which may reduce or impede vent flow. This does not imply that terminations at these locations will assure proper venting in every instance. Because winds fluctuate in velocity, direction, and turbulence, and because these same winds impose varying pressures on the entire structure, no simple method of analysis or reduction to practice exists for this complex situation. Manifold vents may be run horizontally or sloped upwards toward the common vent. Slope should not exceed ¼" per foot unless required otherwise by local codes. Regardless, minimum vent connector rise as determined for each appliance must be maintained.

Manifold vents may be of constant diameter (Fig. 1-5) in which case they are of the same size as the common vent or its equivalent. Manifolds may also be tapered (Fig. 1-6) for the actual input to a particular section of the manifold. Difference in operating characteristics between properly sized constant diameter manifold vents or tapered manifold vents are negligible and choice is usually dictated by convenience and cost.

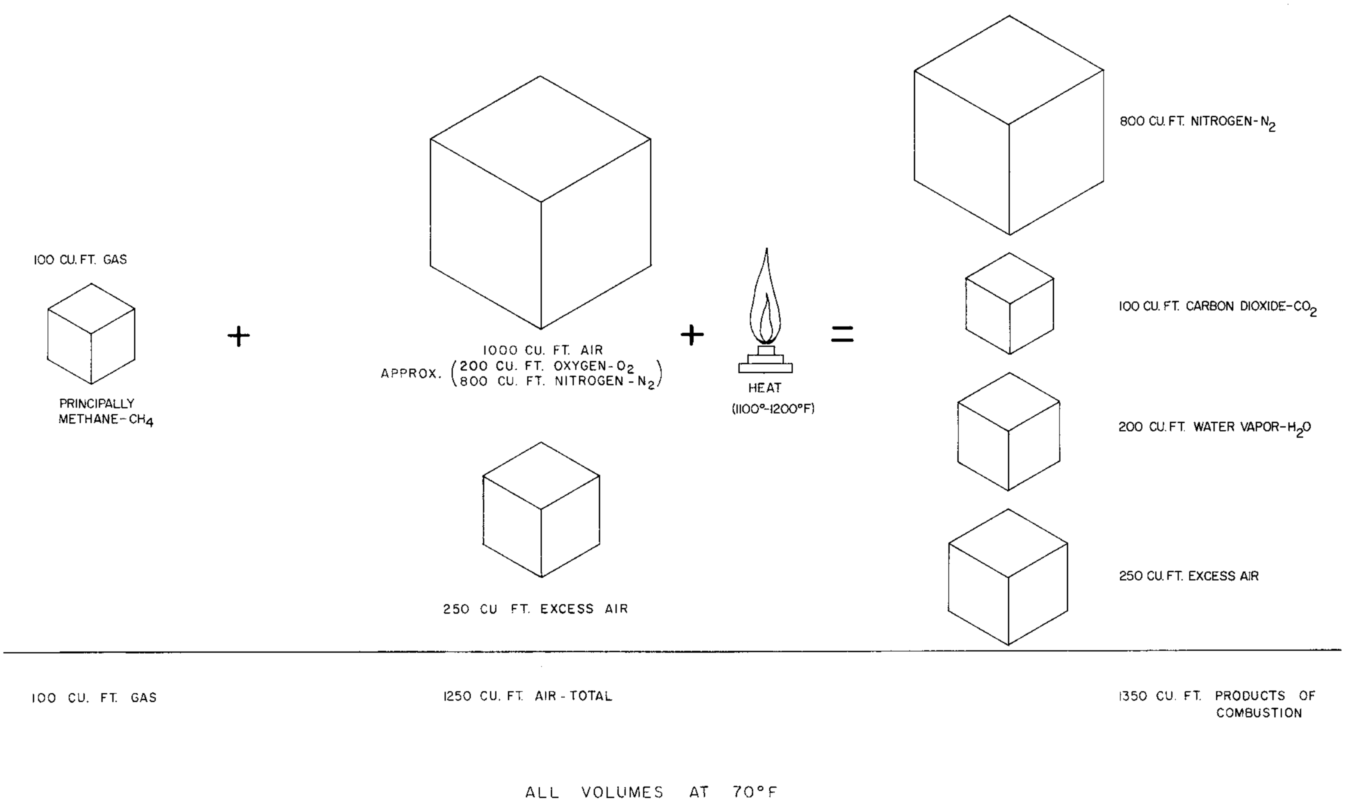
1.4.4 INDIVIDUAL VENTS – Economics thru the use of smaller vent pipe and the elimination of fittings could dictate the use of an individual vent system for each module (see Fig. 1-7) rather than a combined vent system. If the individual vents are of the proper diameter and the total vent height is a minimum of **5** ft., the systems are self venting and more reliable than a combined vent system since, in the latter, it is impossible to anticipate all contingencies.

1.4.5 VENT AND CHIMNEY MATERIALS AND CONSTRUCTION – The materials of construction for vents and chimneys include single-wall metal, various multi-wall air and mass insulated types as well as masonry, which could be precast or site constructed. In many instances, national or local codes will govern what type may be used. Where choice is possible, many advantages can be listed for the UL Listed double wall metal type B vent:

1) warm up is faster with type B vents than vents having greater mass
2) type B vents permit closer clearance to combustible material than single wall metal vents unless special precautions are taken with the latter
3) type B vents are less prone to condensation and corrosion than single wall metal vents
4) type B vents are lightweight, easy to handle and assemble

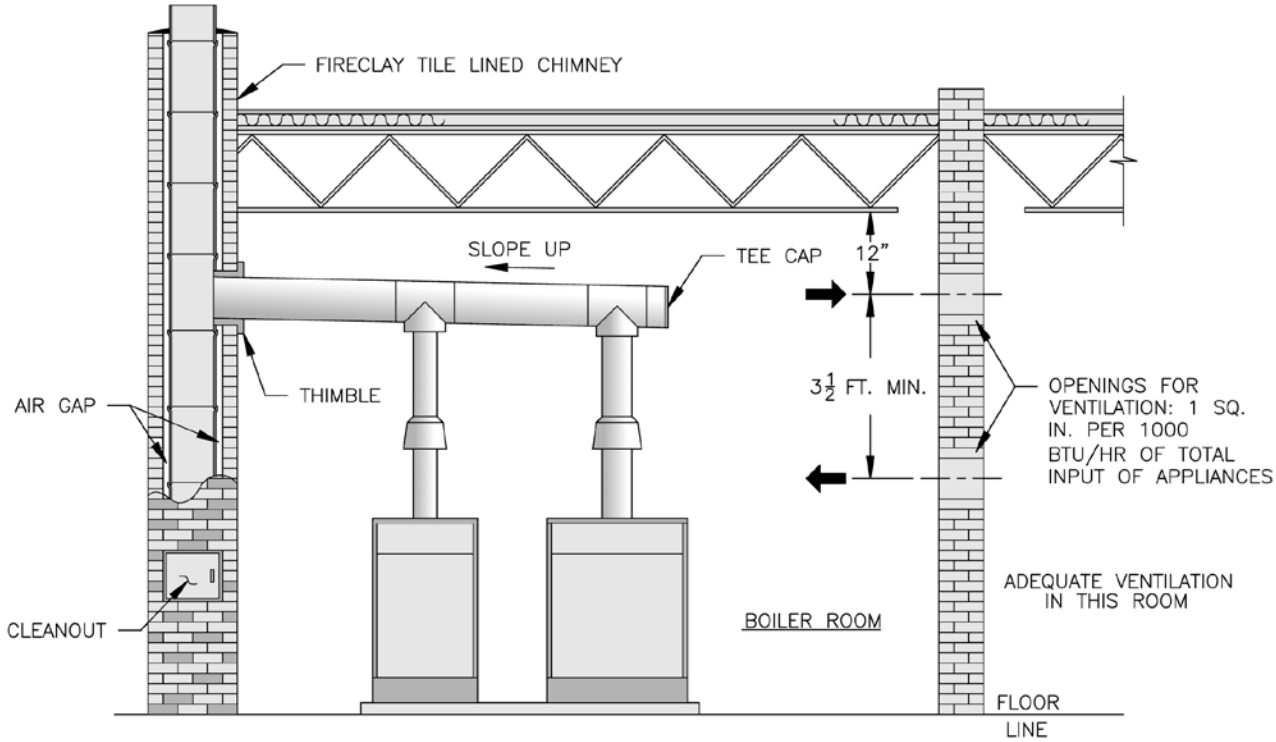
Manufacturer's instructions relative to installation of their product should be followed as long as they comply with the National Fuel Gas Code and/or local codes. Some items to consider are:

1) support of lateral runs so that vent pipe does not sag



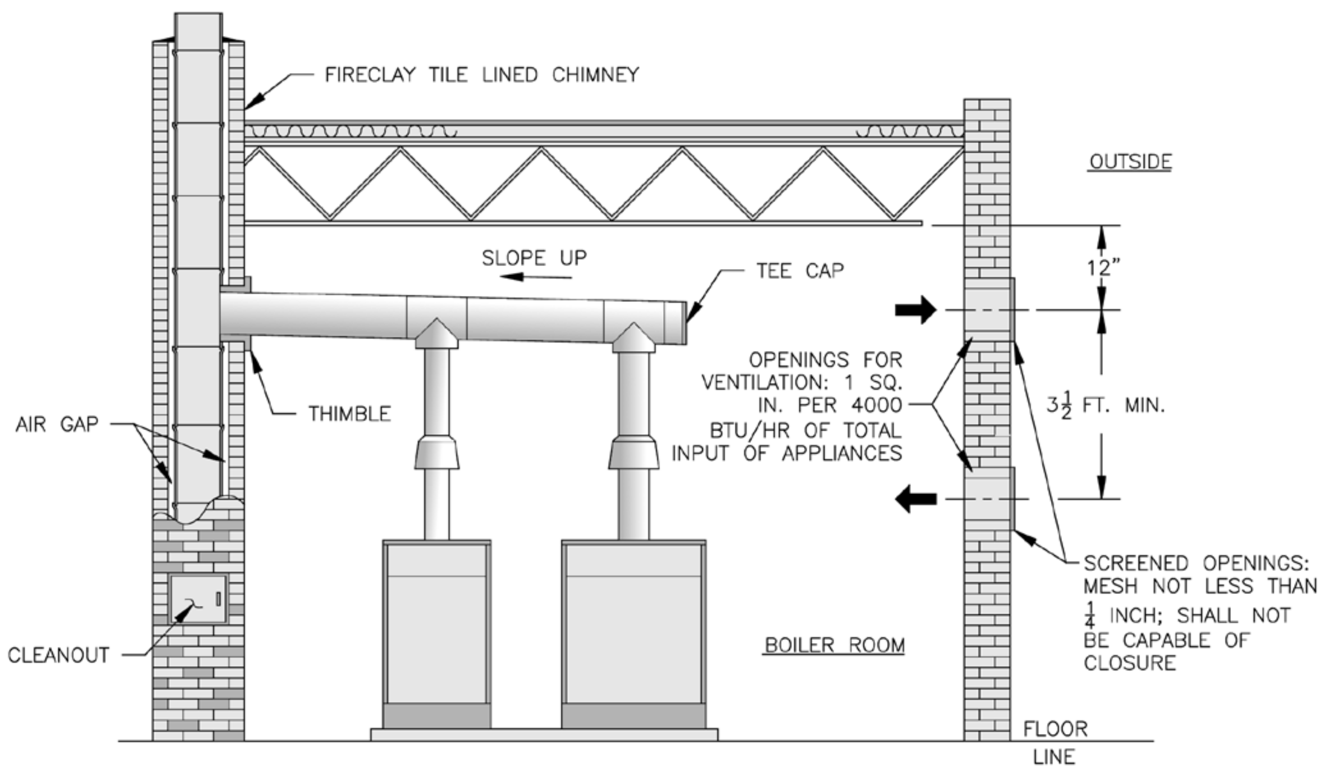
COMPLETE COMBUSTION OF NATURAL GAS

FIGURE 1-1



CONFINED SPACE, VENTILATION AIR PROVIDED FROM INSIDE OF BUILDING

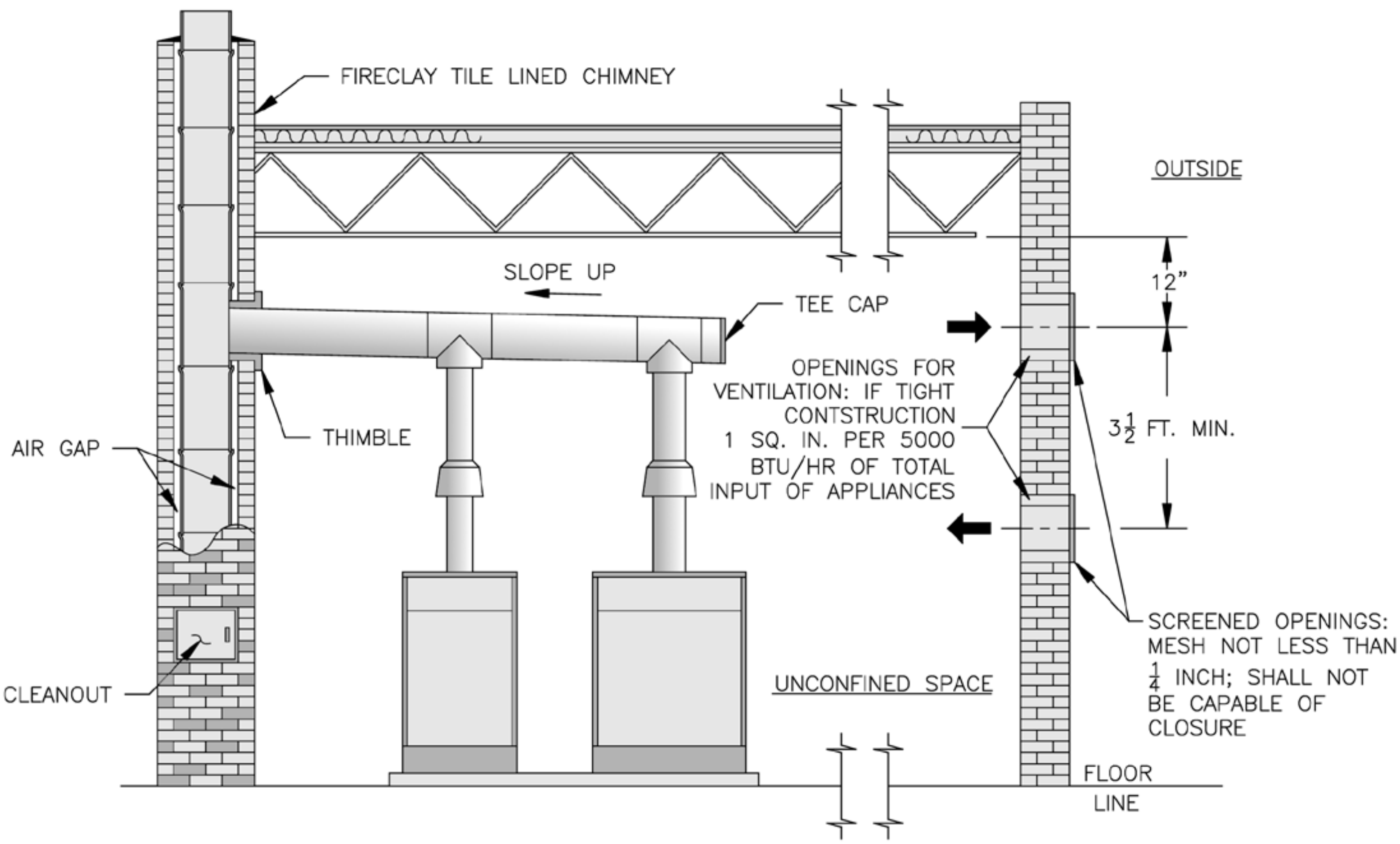
FIGURE 1-2



CONFINED SPACE, VENTILATION AIR PROVIDED FROM OUTDOORS

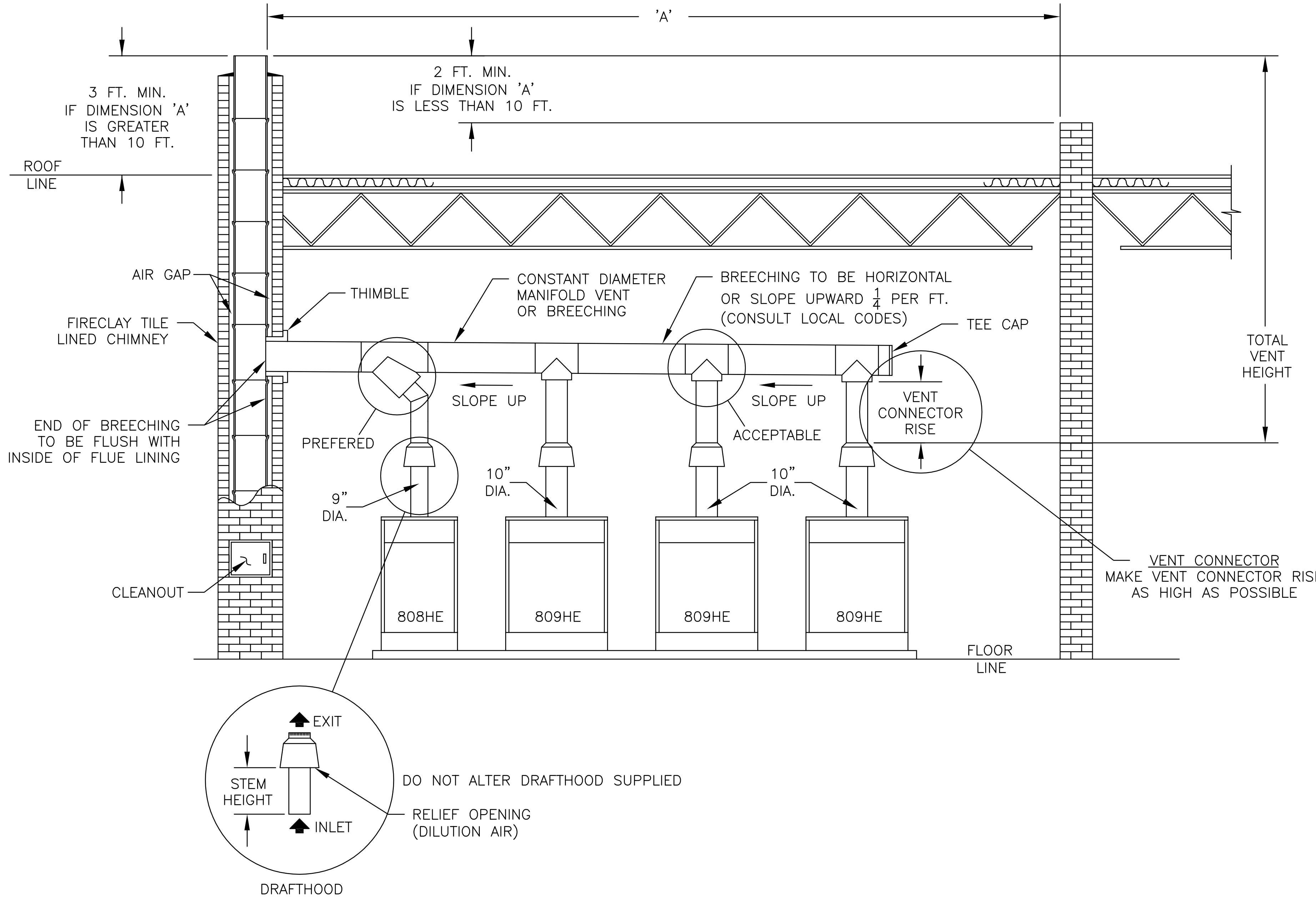
FIGURE 1-3

2) support of common vent where it passes thru a ceiling or roof
3) clearances to combustible material – use of thimbles
4) firestops
5) flashing and storm collars
6) guying or bracing of common vent pipe above roof
7) securing and gas tightness of joints
8) lightning arrester if top of metal vent is one of the highest points on the roof
9) proper termination of vent connection at masonry chimney – vent should enter chimney at a point above the extreme bottom of chimney – vent should be flush with inside of chimney and sealed (see Fig. 1-5)
10) never connect a gas vent to a chimney serving a fireplace unless the fireplace has been permanently sealed
11) never pass any portion of a vent system thru a circulating air duct or plenum.



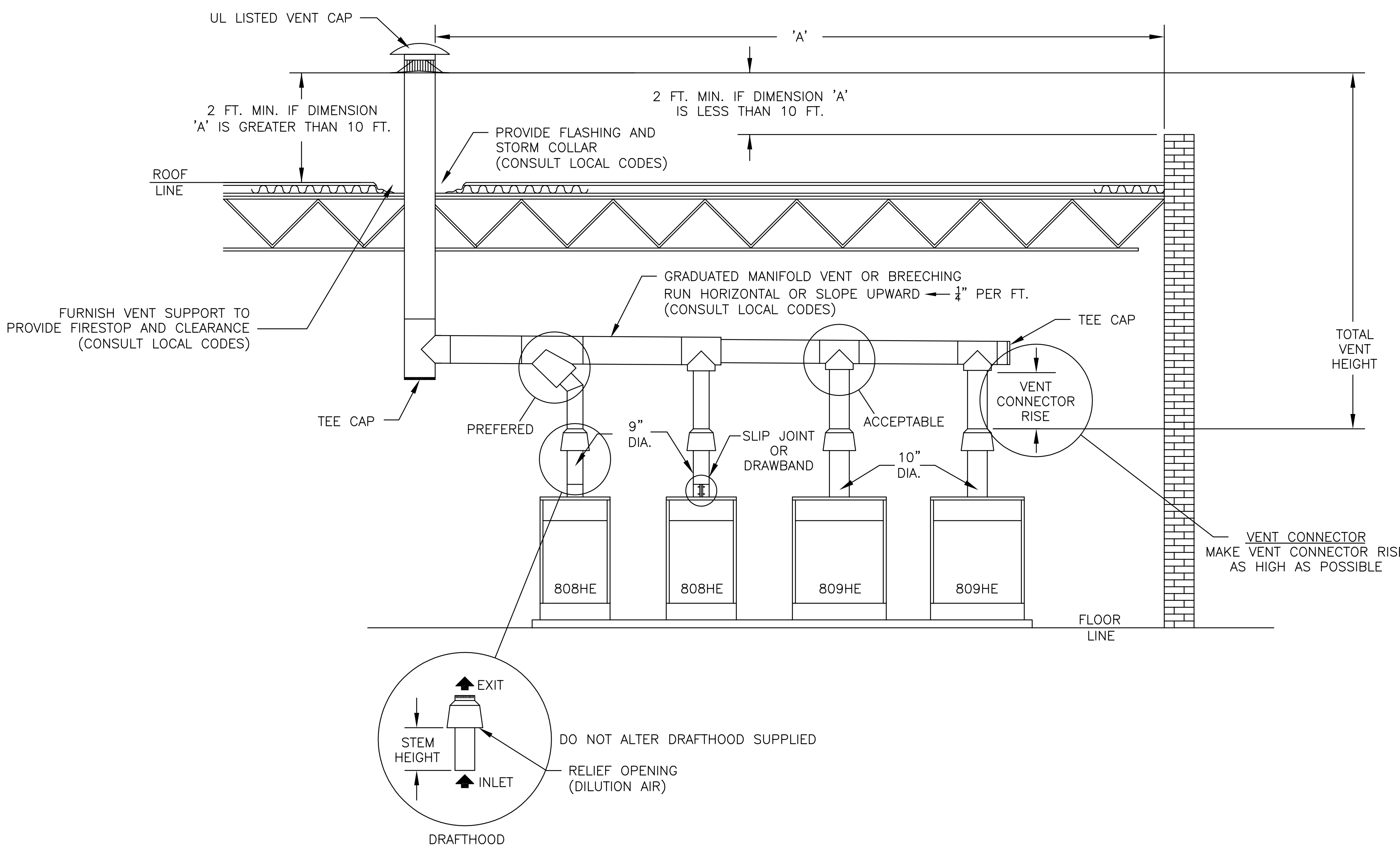
UNCONFINED SPACE—TIGHT CONSTRUCTION
VENTILATION AIR PROVIDED FROM OUTDOORS

FIGURE 1-4



CONSTANT DIAMETER MANIFOLD VENT OR BREECHING
TWO THROUGH EIGHT MODULES

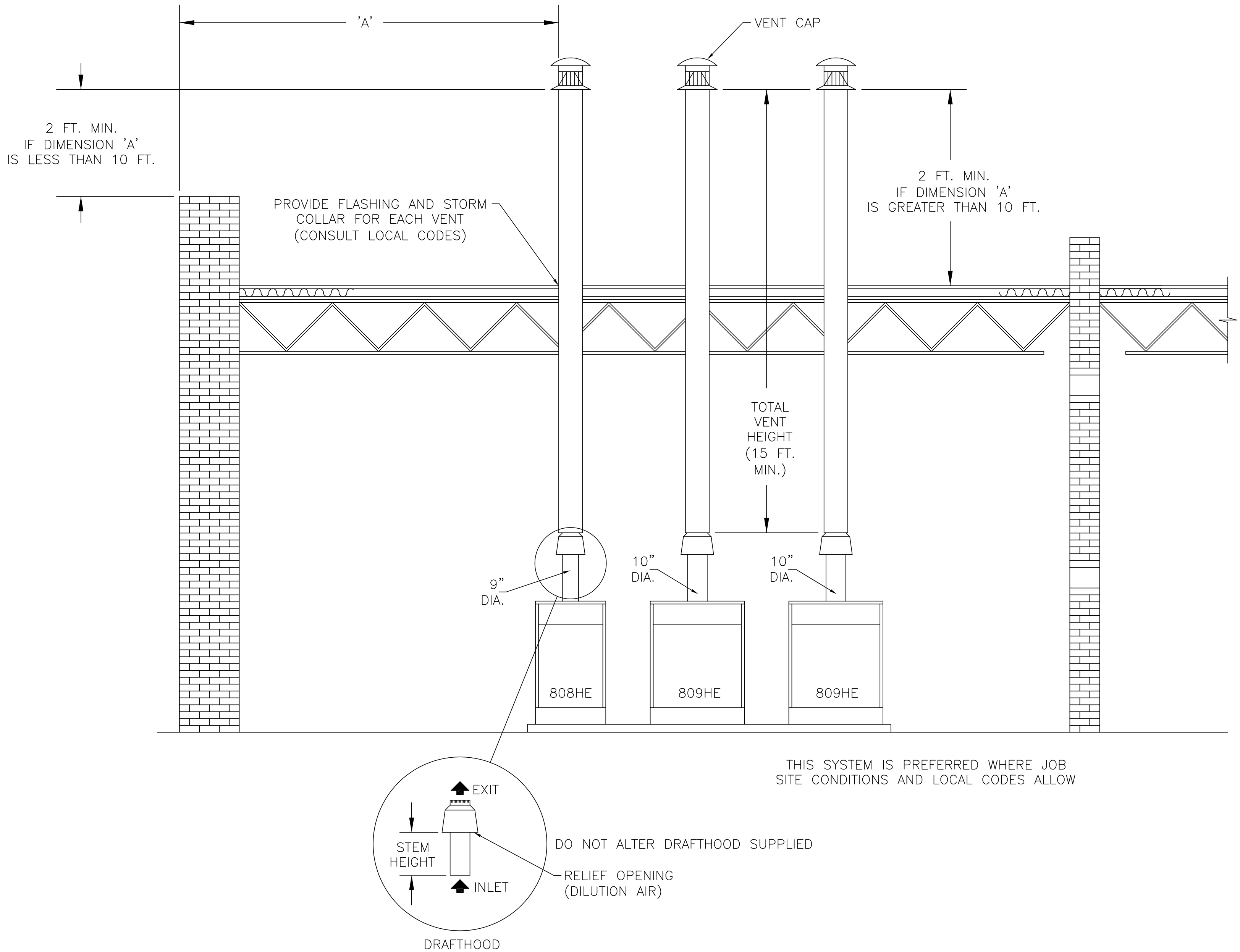
FIGURE 1-5



GRADUATED DIAMETER MANIFOLD VENT OR BREECHING

TWO THROUGH EIGHT MODULES

FIGURE 1-6



INDIVIDUAL VENTS

TWO THROUGH EIGHT MODULES

FIGURE 1-7

SECTION 2.0 VENTS

⚠DANGER

Inspect existing chimney before installing boilers. Failure to clean or replace perforated pipe or tile lining will cause severe injury or death.

2.1 Vents, or breeching ducts, are generally less flexible in design location than are water pipes, gas pipes or electrical lines. To avoid conflicts for a given location, design and layout the vents in this section before proceeding to other sections of this manual.

2.2 Obtain a scaled drawing of the boiler room. Note the floor size, ceiling height, exterior walls, and chimney location, if provided.

2.3 Determine the input required to the system. It is recommended that the heating load be determined by an accurate calculation of the heat loss of the structure using methods contained in the ASHRAE Guide. If service water is to be added capacity as described in paragraph 3.13 of this manual. The boiler capacity so obtained is net rating to input. Record the input required on the boiler room drawing.

2.4 Using Figure 2-2 for the input found in 2.3 above, find the number of modules recommended. Those module combinations shown represent the best selection for lowest first cost. Other combinations may be selected, within the following guidelines:

1) Modules using a sequencing control system, such as Tekmar described in Section 5.0, should not vary by more than one size.
2) Modules using a combined vent system should not vary by more than one size.
3) The combined vent sizing procedures in this section are based on a maximum of eight modules using a common vent system. If it is desired to serve more than eight modules with a common vent system, the specific requirements should be referred to the BURNHAM COMMERCIAL Application Engineering Department.

Refer to Figure 2-3 for individual module inputs.

2.4.1 Sketch on the boiler room drawing the approximate location of the modules. Figures 2-4 thru 2-9 show several layouts that can be used depending on the size and shape of the boiler room and chimney location, if provided. Refer to Figure 2-3 for dimensional data on individual modules. Select the layout which best fits the boiler room. Bear in mind that for combined vent systems it is desirable to keep horizontal laterals as short as possible. On a combined vent system for which a fixed chimney is provided, it is desirable to place the first module close to the chimney.

2.4.2 If the factory fabricated water manifolds are to be used, 805H, 806H, and 807HE modules should be laid out with 28½" module spacing and 808HE, 809HE, and 810HE modules should be laid out with 40" module spacing. If an 807HE and an 808HE module are to be connected to a common manifold, use the longer manifold with 40" spacing. Otherwise, any module spacing that allows at least 1 inch jacket –to-jacket spacing if acceptable, pending local or state code requirements that may require greater module to module spacing.

2.4.3 Refer to Figure 2-10 for minimum clearances around modules to combustible materials and for service access. CAUTION: Local fire ordinances may be more restrictive and should be complied with.

2.5 One of the serious errors made in layout of a boiler room is the failure to provide sufficient ventilation air. Insufficient ventilation air will cause incomplete combustion, poor ignition, accumulation of soot in the boiler, or the production of toxic gases. Many service calls for dirty boilers, nuisance lock outs, noisy ignition, or obnoxious odors are traceable to insufficient ventilation air. Use Figure 2-11 at the input desired to find the recommended free area of the ventilation opening required. Reference to Figures 1-2 thru 1-4 should be made in order to understand the types of installations described in the headings of Figure 2-11. Record the free ventilation area required on the plans of the boiler room and sketch the openings like those shown in figures 1-2 thru 1-4 respectively.

2.6 Individual vents as shown in Figure 1-7 are highly recommended if the job site conditions allow. Individual vents are particularly useful in boiler rooms having a low ceiling height. Individual vents are easy to design and in many cases result in the lowest installed cost. They also are the most dependable in operation and less susceptible to condensation than are combined vents. To size individual vents, use Figure 2-12 with the vent height available, the lateral length, size of module and type of vent pipe.

2.7 Combined vents will perform satisfactorily if strict design procedures are followed. Referring to Figures 2-4 thru 2-9, note that a connector rise F of at least one foot is required. A connector rise F of three feet is desirable. Thus, to make the desired connector rise and have space for the manifold vent, the minimum boiler room ceiling height must be equal to:

32½"	Module Height
+)	Drafthood Height
+ F	Minimum Connector Rise
+ CV	Manifold Diameter
+ 6"	Clearance
=	Minimum Ceiling Height

If the minimum ceiling height above is not available, common vents will not perform satisfactorily and should not be used.

2.7.1 If the minimum ceiling height is available, proceed to size the common vent CV in Figure 2-13. Enter the left hand column at the desired total input and move right to the column corresponding to your H, least total vent height, and read the diameter of the common vent. If more than one elbow is used, increase CV by one pipe size for each elbow more than one. Proceed to size the connector rise diameter CN by entering Figure 2-14 at H available and move right to the column headed F. On the line for available connector rise move right to the CN columns headed by the module sizes selected in 2.4 above. Read the connector diameter(s). Record these sizes on the plans of the boiler room.

2.7.2 If a tapered or graduated manifold vent is desired, use the same procedures above for sizing the intermediate manifold diameter but for the total input of the modules served by intermediate tapered or graduated manifold vent.

2.7.3 Within Figure 2-12 are several entries of NR. This means that the combination involved is not recommended. The most common reason for a combination to be designated NR is that condensation inside the vent pipe is likely to occur. This is particularly true of single wall vent pipe. Combinations outside the shaded area in Figure 2-13 are also not recommended for single wall vent pipe. Additionally, single wall vent pipe should not be used with five or more modules because the dilution from the unfired modules plus the lower surface temperature of single wall pipe makes condensation and the resulting corrosion very likely.

2.8 If a masonry chimney is desired, the minimum cross sectional area of the chimney is found in Figure 2-15 as a function of the vent diameter. Figure 2-16 shows the area of standard chimney tiles by size.

2.9 The following is an example of the recommended design procedures.

Example: A 3 story apartment house needs a total boiler capacity including service water hating, of 1,849,500 Btu/Hr net rating. The boiler room is in a one story added portion of the building, of non-combustible construction, similar to Figures 1-6 or 1-7 and is 20 feet long, 10 feet wide with a clear ceiling of 12 feet. No chimney is provided. Select and size the vent system.

1) Refer to Figure 2-1 to convert net rating to input. Input = 1,849,500 x 1.44 = 2,663,280 Btuh = 2,663 MBH.

2) From Figure 2-2 find the closest recommended module combination having an input of 2663 MBH. It is found that an input of 2710 MBH is the closest size and is composed of five 809HE and one 808HE modules.

3) Sketch approximate module locations on the boiler room plans using minimum clearances recommended in 2.4 above. In this case there is space to lay-out the five modules in line along one wall on 40” centers with ample service clearances, front, rear, and sides, per Figure 2-10.

4) Determine the ventilation areas required from figure 2-11. It is a confined space but outdoor air is readily available through vents in the exterior wall. Use the equation for Confined with Outdoor Vent:

$$\frac{\text{MBH Input}}{} = \frac{2{,}710.}{4.0} = 677.5 \text{ sq. in.}$$

of free ventilation area required.

5) Select the type of vent system – individual or combined.

For an individual vent system use Figure 2-12 to determine the vent size(s). In this example, the height of drafthoods above the floor = 32½” + 33½” = 66” = 5½ feet. The least total vent height is calculated from the drafthood up to the top of the vent pipe which must be at least two feet above the roof.

	12 Ft. Ceiling Height
-	5½ Ft. Drafthood Height
+	2 Ft. Ceiling Thickness
+	2 Ft. Vent Extension
=	10½ Ft. total Vent Height, H

Enter Figure 2-12 at H = 10 Ft. and move right to L = O Ft. Move right to 809HE column and find 8” diameter for type B pipe and 10” for single wall pipe. Continue to the right on the same line to 809HE column and find 9” diameter for type B pipe and 10” for single wall pipe. Mark these sizes on the drawing of the boiler room. If no more than two 90° elbows are used in the system, no corrections are necessary. The design is complete.

6) If a combined vent is desired such as in Figure 1-5, use Figure 2-13 to find the common vent size, CV. Enter Figure 2-13 at 2710. MBH input. Move right to the column H = 10 Ft. and find common vent diameter CV = 26” for type B pipe and single wall is not recommended. Enter Figure 2-14 at H = 10 Ft. and move right to F = 3 Ft. Move right and find connector diameter CN of 12” in the 809HE column and 12” in the 810HE column. Calculate minimum ceiling height.

	32½”	Module Height
+	33½”	Drafthood Height, D
+	36”	Desired connector Rise, F
+	26”	Manifold Diameter, CV
+	6”	Clearance
=	11’2”	Minimum Ceiling Height

A twelve foot clear ceiling height will work. With only one elbow, no correction is necessary. The design of a constant diameter manifold vent is complete. Mark these vent and connector sizes on the drawing of the boiler room.

7) If a tapered or graduated manifold vent is desired, such as in Figure 1-6 the horizontal and vertical portion of the vent serving five modules is also complete with 6) above. However, to size the manifold vent at an intermediate position such as CV3 in Figure 2-4, use Figure 2-13 for the MBH Input of the modules served by that position of the manifold vent. The Input MBH of each module can be determined from Figure 2-3. In this case CV3 serves two modules having an input of 920 MBH. Enter figure 2-13 at an input of 920 MBH. Move right to H = 10 Ft. and find CV3 = 14" diameter. Mark this vent diameter size on the drawing of the boiler room. Thus a graduated manifold vent design is complete. It is possible with this procedure to reduce the manifold vent size after each module. However, from a practical standpoint, the cost of fittings may offset the lower cost of smaller vent pipe.

2.10 All of the above procedure is based on data found in the ASHRAE Guide, 1975 Equipment Volume, Chapter 26. The basic chimney equation is expressed as follows:

$$I = 4.13 \times 10^5 \times \frac{(di)^2}{M} \times \frac{(\Delta PB)^{0.5}}{(KTm)}$$

where: I = Operating heat input, BTUH

di = Inside diameter of the common vent or manifold vent

M = Mass flow input ratio, lb. of products per 1000 BTU of fuel burned. A value of 1.60 was used based on 5.3% CO_2 after dilution. An additional 15% dilution was added for each unfired module.

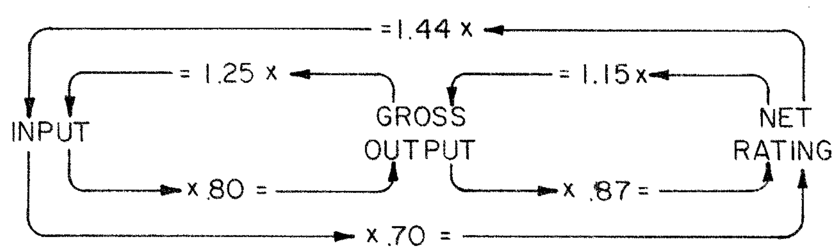
ΔP = Pressure difference or loss in the system acting to cause flow, inches of water. Use 0.537 inches water per 100 Ft. of pipe.

B = Sea level barometer used —29.92" Hg

K = Resistance loss coefficients, dimensionless.

Tm = Temperature in vent system at average conditions, °Fabs.

The serious Engineer should become familiar with the above basic equation and the range of the variables that may be encountered. The tables in Figures 2-12 thru 2-14 should not be extrapolated. If system conditions do not fall within the limit of the tables, vent sizes must be calculated using the chimney equation above as described in the ASHRAE Guide.



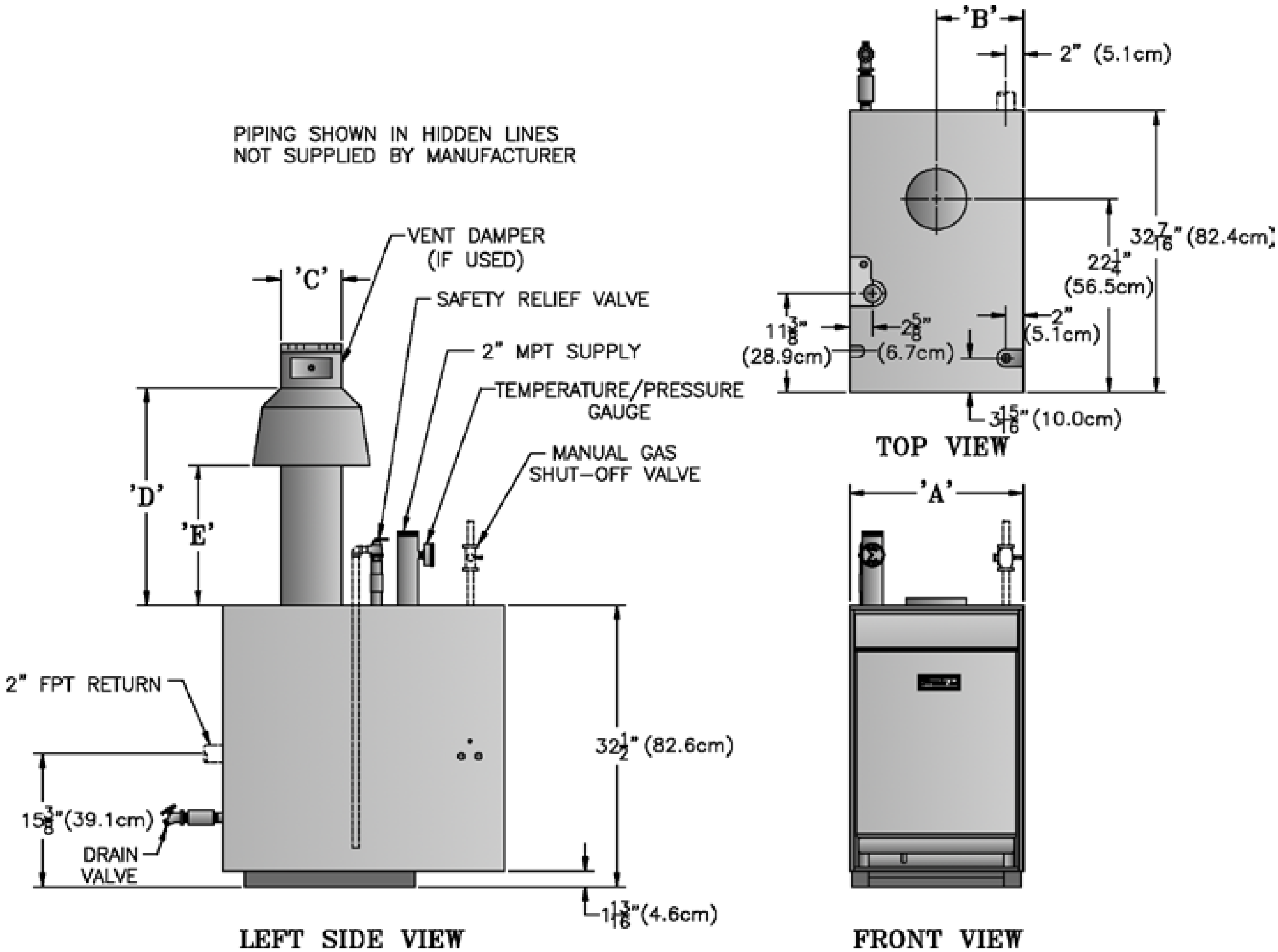
RELATIONSHIP OF INPUT, GROSS OUTPUT, AND NET RATING FOR SERIES 8H/8HE MODULES

FIGURE 2-1

Total Input MBH	Recommended Number of Modules					
	805H	806H	807HE	808HE	809HE	810HE
504	2					
567	1	1				
630		2				
655		1	1			
680			2			
750			1	1		
820				2		
870				1	1	
920					2	
965					1	1
1010						2
1090			2	1		
1160			1	2		
1230				3		
1280				2	1	
1330				1	2	
1380					3	
1425					2	1
1470					1	2
1515						3
1570			1	3		
1640				3	1	
1690				3	1	
1740				2	2	
1790				1	3	
1840					4	
1885					3	1
1930					2	2
1975					1	3
2020						4
2100				4	1	
2150				3	2	
2200				2	3	
2250				1	4	

Total Input MBH	Recommended Number of Modules		
	808HE	809HE	810HE
2300		5	
2345		4	1
2390		3	2
2435		2	3
2480		1	4
2525			5
2610	3	3	
2660	2	4	
2710	1	5	
2760		6	
2805		5	1
2850		4	2
2895		3	3
2940		2	4
2985		1	5
3030			6
3070	3	4	
3170	1	6	
3220		7	
3265		6	1
3310		5	2
3355		4	3
3400		3	4
3475		2	5
3490		1	6
3535			7
3630	1	7	
3680		8	
3725		7	1
3770		6	2
3815		5	3
3860		4	4
3905		3	5
3850		2	6
3995		1	7
4040			8

FIGURE 2-2



Boiler Model	Input (MBH)	Dimensions (inch)					Recommended Chimney Size (Round)	Water Content (Gallons)	Approx. Shipping Weight (LB)
		"A'	"B"	"C"	"D"	"E"			
805H	252	20	10	7	24-13/16	16-1/8	7" dia. x 15 ft.	11.9	680
806H	315	23-3/4	11-7/8	8	27-13/16	18	8" dia. x 15 ft.	13.9	770
807HE	340	27-1/2	13-3/4	9	27-13/16	18	8" dia. x 15 ft	15.9	870
808HE	410	31-1/4	15-5/8	9	30-13/16	20	8" dia. x 15 ft	17.9	950
809HE	460	35	17-1/2	10	33-1/2	22	10" dia. x 15 ft	19.9	1040
810HE	505	38-3/4	19-3/8	10	33-1/2	22	10" dia. x 15 ft	21.9	1140

(1) Special base required for installations on combustible flooring; adds 4-3/4" to boiler height (floor to jacket top panel is 37-1/4").

(2) Gas connection size: 1 NPT

(3) Maximum Allowable Working Pressure: 50 psi (Water Only)

(4) Items shown in hidden lines supplied by installer.

FIGURE 2-3

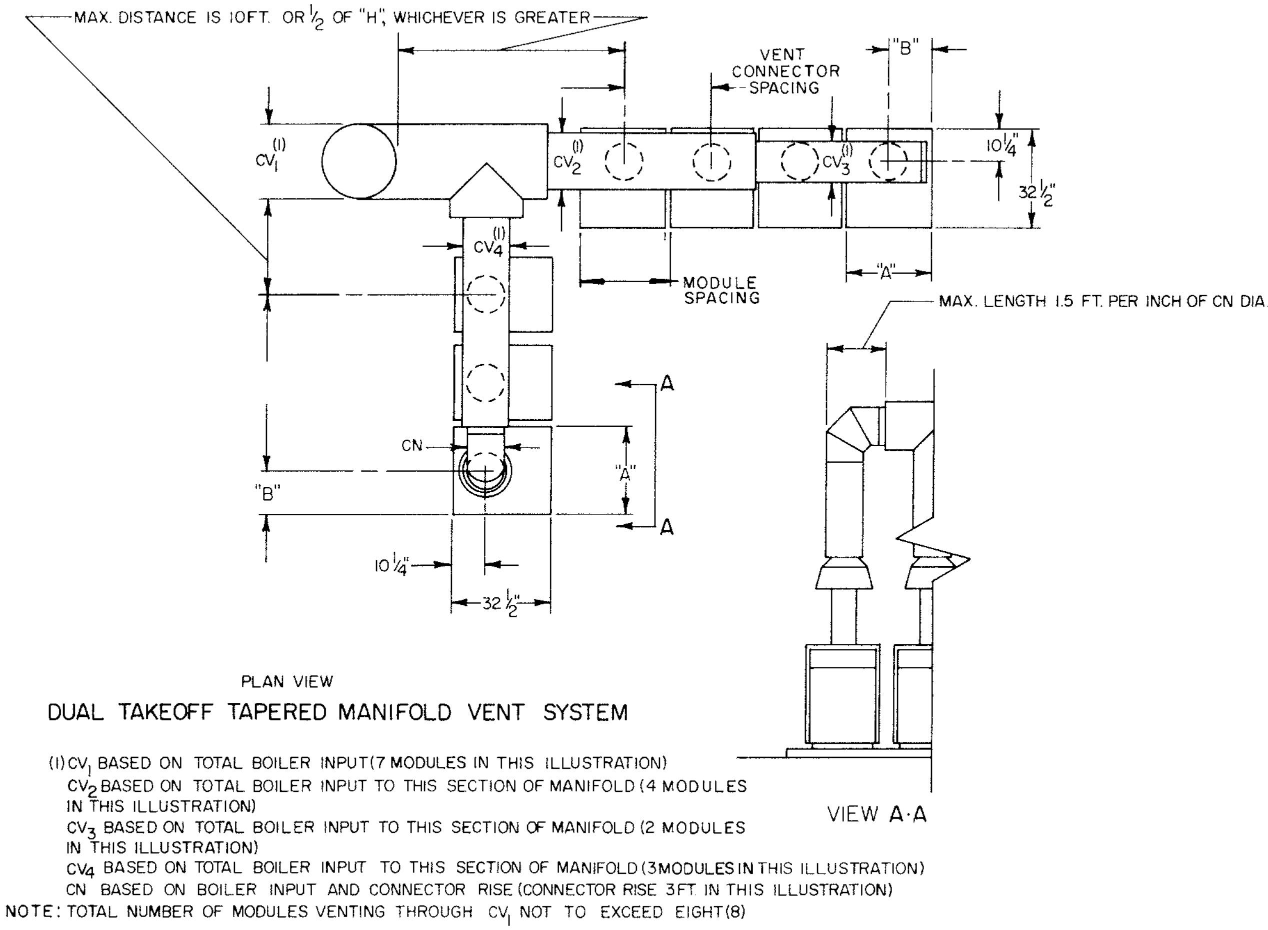


FIGURE 2-4

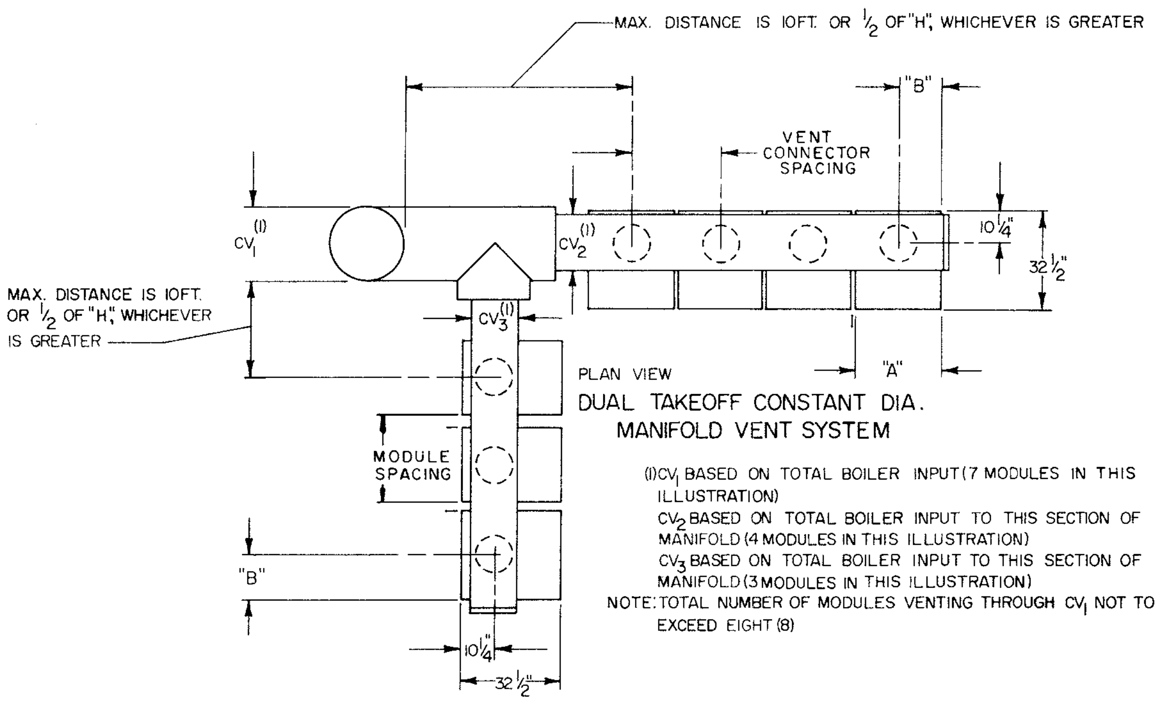
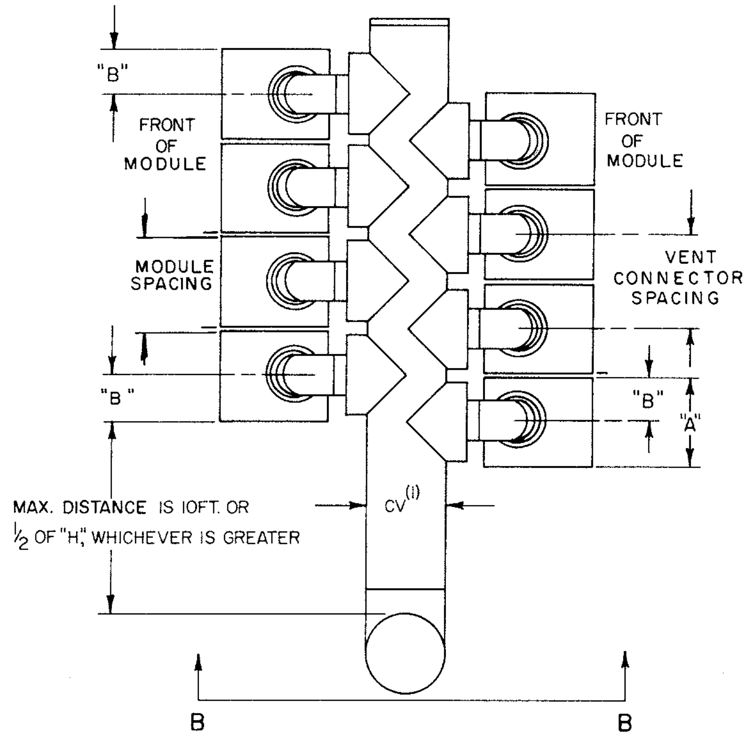


FIGURE 2-5

FIGURE 2-6



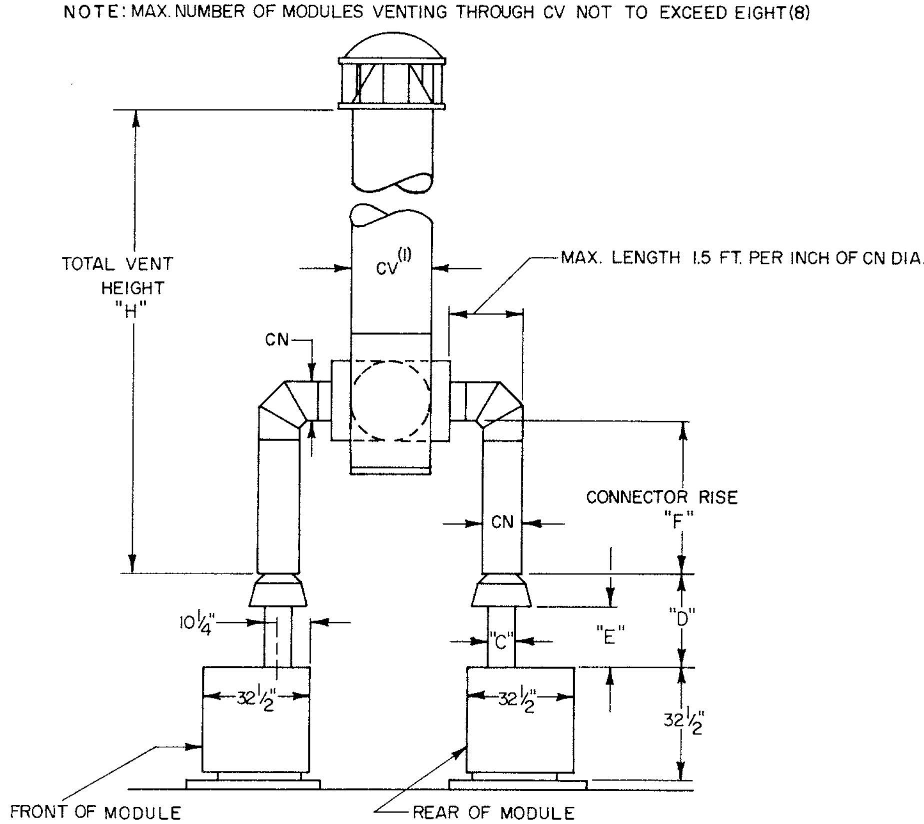
PLAN VIEW

CONSTANT DIA. MANIFOLD VENT SYSTEM

(1) CV DIA. BASED ON TOTAL BOILER INPUT

NOTE: MAX. NUMBER OF MODULES VENTING THROUGH CV NOT TO EXCEED EIGHT (8)

FIGURE 2-7

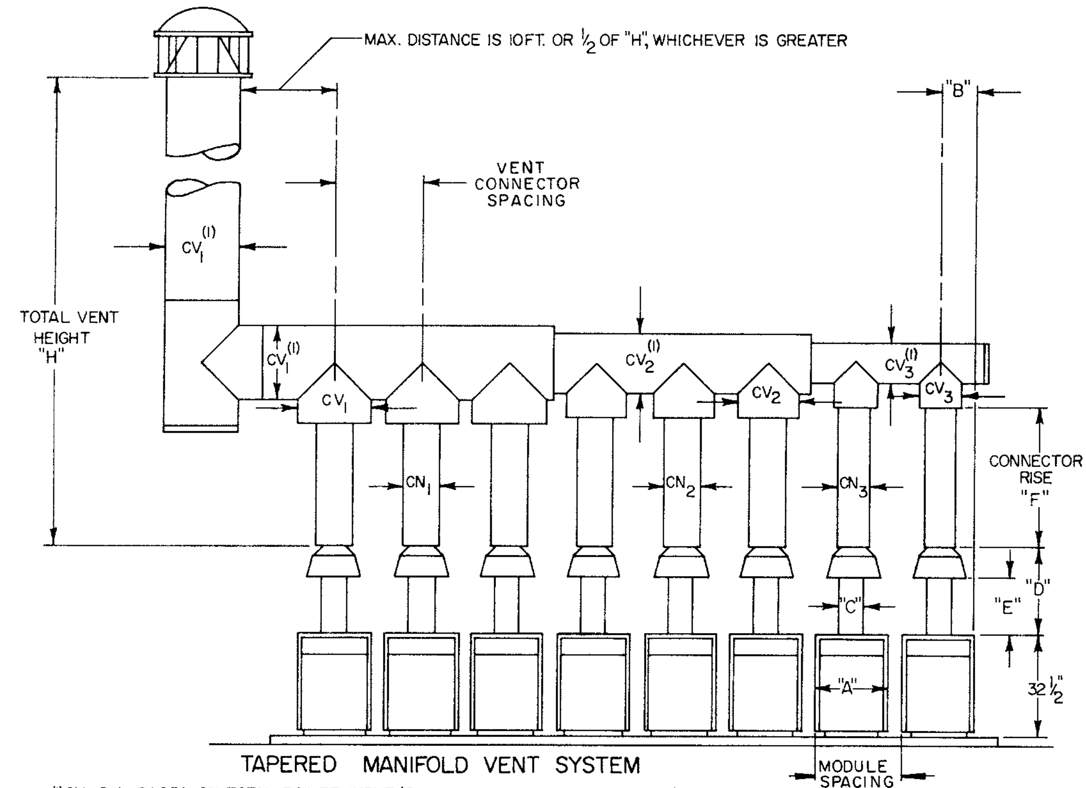


VIEW B-B

CONSTANT DIA. MANIFOLD VENT SYSTEM

(1) CV DIA. BASED ON TOTAL BOILER INPUT

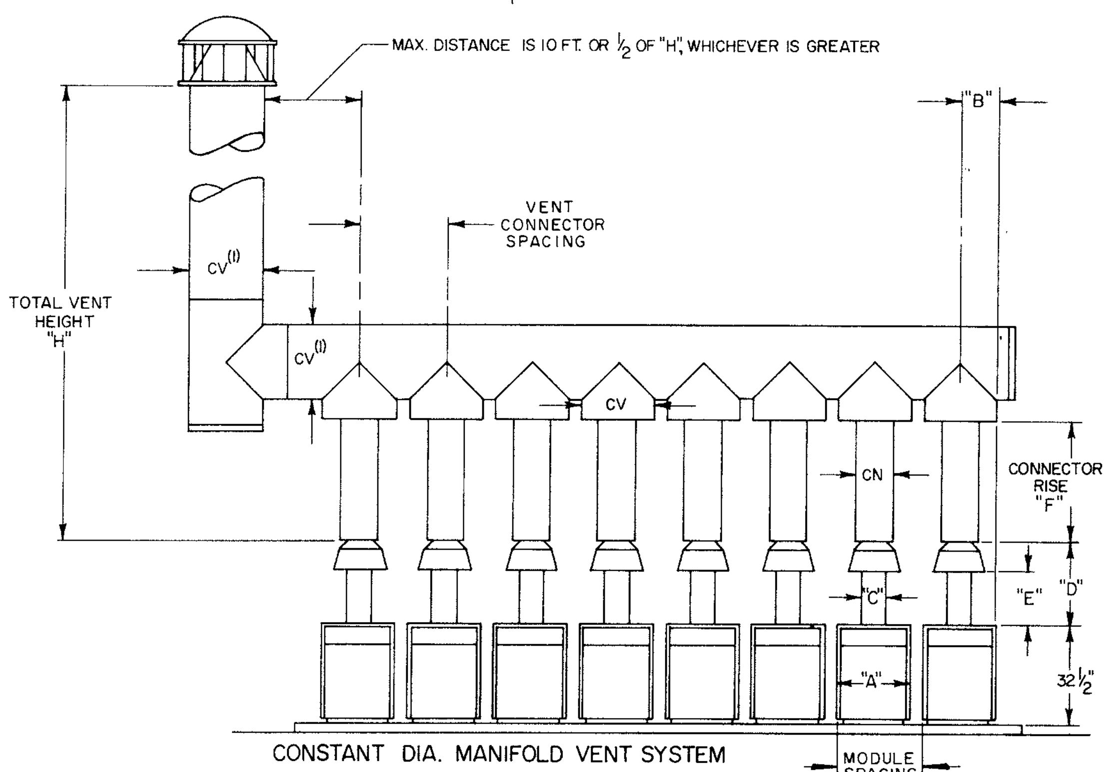
FIGURE 2-8



TAPERED MANIFOLD VENT SYSTEM

(1) CV_1 DIA. BASED ON TOTAL BOILER INPUT (8 MODULES IN THIS ILLUSTRATION)
CV_2 DIA. BASED ON TOTAL BOILER INPUT TO THIS SECTION OF MANIFOLD (5 MODULES IN THIS ILLUSTRATION)
CV_3 DIA. BASED ON TOTAL BOILER INPUT TO THIS SECTION OF MANIFOLD (2 MODULES IN THIS ILLUSTRATION)
NOTE: MAX. NUMBER OF MODULES VENTING THROUGH CV_1 NOT TO EXCEED EIGHT (8)

FIGURE 2-9



CONSTANT DIA. MANIFOLD VENT SYSTEM

(1) CV DIA. BASED ON TOTAL BOILER INPUT

NOTE: MAX. NUMBER OF MODULES VENTING THROUGH CV, NOT TO EXCEED EIGHT (8)

	Drafthood & Vent Connector	Top of Jacket	Front	Side	Rear	5 6 Side-by-Side	6 Back-to-Back	6 Front-to-Front
805-806-807								
To Combustible Construction	1 6"	2 36"	1 18"	1 6"	1 6"	N/A	N/A	N/A
Recommended For Servicing	N/A	1 24"	1 24"	8 18"	24"	1 1"	26"	7 36"
808-809-810								
To Combustible Construction	1 6"	2 51½"	1 18"	1 6"	1 6"	N/A	N/A	N/A
Recommended For Servicing	N/A	7 24"	7 24"	8 18"	24"	1 1"	26"	7 36"

N/A: Not Applicable, 1 USA & Canada, 2 USA Only: 18" in Canada, 5 or as necessitated by prefabricated water manifolds, 6 Consult Local Codes for minimum spacing of multiple boilers, 7 USA Only; 48" in Canada, 8 USA Only; 24" in Canada.

MINIMUM INSTALLATION CLEARANCES AROUND MODULES

FIGURE 2-10

Unconfined Space with Outdoor Vent	Confined Space with Outdoor Vent	Confined Space w/Inside Air
MBH Input 5.0	MBH Input 4.0	MBH Input 1.0
MBH Input refers to total input for all appliances in the boiler room.		

TOTAL FREE AREA OF VENTILATION OPENINGS, SQ. IN.

FIGURE 2-11

1

INDIVIDUAL VENTS
DIAMETER OF VENTS SERVING A <u>SINGLE</u> MODULE (SEE FIGURE 1-7)

1

Least Total Vent Height H, Ft.	Horizontal Lateral Length L, Ft.	805H Dia., In. Type B, Double Wall Vent	805H Dia., In. Single Wall Metal Vent	806H Dia., In. Type B, Double Wall Vent	806H Dia., In. Single Wall Metal Vent	807HE Dia., In. Type B, Double Wall Vent	807HE Dia., In. Single Wall Metal Vent	808HE Dia., In. Type B, Double Wall Vent	808HE Dia., In. Single Wall Metal Vent	809HE Dia., In. Type B, Double Wall Vent	809HE Dia., In. Single Wall Metal Vent	810HE Dia., In. Type B, Double Wall Vent	810HE Dia., In. Single Wall Metal Vent
6	0	7	8	8	10	8	10	9	10	9	10	10	12
	2	8	8	9	10	9	10	10	10	12	12	12	12
	5	8	10	9	10	9	10	10	12	12	12	12	12
	12	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
8	0	7	7	7	8	8	8	8	10	9	10	9	10
	2	8	8	8	10	9	10	9	10	10	12	10	12
	5	8	8	9	10	9	10	10	10	10	12	12	12
	10	NR	10	NR	10	NR	10	NR	12	NR	12	NR	12
	15	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
10	0	6	7	7	8	7	8	8	10	9	10	9	10
	2	7	8	8	10	8	10	9	10	10	10	10	10
	5	7	8	8	10	8	10	9	10	10	10	10	12
	10	8	8	8	10	9	10	9	10	10	12	10	12
	15	NR	8	NR	10	NR	10	NR	10	NR	12	NR	12
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
15	0	6	7	7	8	7	8	8	8	8	10	8	10
	2	7	7	7	8	8	8	8	10	9	10	9	10
	5	7	8	8	8	8	10	9	10	9	10	9	10
	10	7	8	8	10	8	10	9	10	9	10	10	10
	15	7	8	8	10	8	10	9	10	9	10	10	12
	20	NR	8	NR	10	NR	10	NR	10	NR	10	NR	12
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
20	0	6	6	7	7	7	7	7	8	8	8	8	10
	2	7	7	7	8	7	8	8	10	8	10	9	10
	5	7	7	7	8	8	8	8	10	8	10	9	10
	10	7	8	7	8	8	8	8	10	9	10	9	10
	15	7	8	8	8	8	10	8	10	9	10	9	10
	20	7	8	8	10	8	10	8	10	9	10	9	10
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
30	0	6	6	6	7	7	7	7	8	7	8	8	8
	2	6	7	7	7	7	8	8	8	8	10	8	10
	5	6	7	7	8	7	8	8	8	8	10	8	10
	10	6	7	7	8	7	8	8	10	8	10	8	10
	15	7	7	7	8	7	8	8	10	8	10	9	10
	20	7	8	7	8	7	8	8	10	8	10	9	10
	30	7	NR	7	NR	8	10	8	10	9	10	9	10

1

To use this table: (1) Enter left hand column at desired least total vent height; (2) Move to the right to second column of the line for desired horizontal lateral length; (3) Move to the right to size of module and type of vent pipe; (4) Pick off minimum vent. Single Wall and Type B Vent Diameters are based on NFPA 54.
WARNING - DO NOT USE ANY PART OF THIS TABLE FOR COMBINED VENTS.

1

FIGURE 2-12

2 - 8 2 - 8

CV - Diameter of Common Vent, Inches

<table>
<tr><th rowspan="2">Input MBH</th><th colspan="5">H - Least Total Vent Height (Ft)</th></tr>
<tr><th>6</th><th>10</th><th>15</th><th>20</th><th>30</th></tr>
<tr><td>504</td><td rowspan="4">14</td><td rowspan="2">12</td><td rowspan="4">12</td><td>10</td><td rowspan="2">10</td></tr>
<tr><td>567</td><td rowspan="5">12</td></tr>
<tr><td>630</td><td rowspan="7">14</td><td rowspan="7">12</td></tr>
<tr><td>655</td></tr>
<tr><td>680</td><td rowspan="5">16</td><td rowspan="6">14</td></tr>
<tr><td>750</td></tr>
<tr><td>820</td><td rowspan="7">14</td></tr>
<tr><td>870</td></tr>
<tr><td>920</td></tr>
<tr><td>965</td><td rowspan="4">18</td><td rowspan="4">16</td><td rowspan="7">14</td></tr>
<tr><td>1010</td><td rowspan="4">16</td></tr>
<tr><td>1090</td></tr>
<tr><td>1160</td></tr>
<tr><td>1230</td><td rowspan="4">20</td><td rowspan="4">18</td><td rowspan="8">18</td><td rowspan="5">16</td></tr>
<tr><td>1280</td></tr>
<tr><td>1330</td></tr>
<tr><td>1380</td><td rowspan="7">16</td></tr>
<tr><td>1425</td><td rowspan="5">22</td><td rowspan="5">20</td></tr>
<tr><td>1470</td><td rowspan="7">18</td></tr>
<tr><td>1515</td></tr>
<tr><td>1570</td></tr>
<tr><td>1640</td></tr>
<tr><td>1740</td><td rowspan="7">24</td><td rowspan="7">22</td><td rowspan="7">20</td></tr>
<tr><td>1790</td></tr>
<tr><td>1840</td><td rowspan="9">18</td></tr>
<tr><td>1885</td><td rowspan="7">20</td></tr>
<tr><td>1930</td></tr>
<tr><td>1975</td></tr>
<tr><td>2020</td></tr>
<tr><td>2100</td><td rowspan="3">26</td><td rowspan="3">24</td><td rowspan="3">22</td></tr>
<tr><td>2150</td></tr>
<tr><td>2200</td></tr>
</table>

NOTE: Shaded Area indicates acceptable applications for Single Wall Metal Vent of the same diameter as Type B vent. Otherwise, Single Wall Metal Vent is not recommended.

2 - 8 2 - 8

FIGURE 2-13

2 - 8 2 - 8

<table>
<tr><th rowspan="2">Input MBH</th><th colspan="5">H - Least Total Vent Height (Ft)</th></tr>
<tr><th>6</th><th>10</th><th>15</th><th>20</th><th>30</th></tr>
<tr><td>2250</td><td rowspan="11">28</td><td rowspan="15">26</td><td rowspan="15">24</td><td rowspan="9">22</td><td rowspan="8">20</td></tr>
<tr><td>2300</td></tr>
<tr><td>2345</td></tr>
<tr><td>2390</td></tr>
<tr><td>2435</td></tr>
<tr><td>2480</td></tr>
<tr><td>2525</td></tr>
<tr><td>2610</td></tr>
<tr><td>2660</td><td rowspan="10">22</td></tr>
<tr><td>2710</td><td rowspan="12">24</td></tr>
<tr><td>2760</td></tr>
<tr><td>2805</td><td rowspan="9">30</td></tr>
<tr><td>2850</td></tr>
<tr><td>2895</td></tr>
<tr><td>2940</td></tr>
<tr><td>2985</td><td rowspan="9">28</td><td rowspan="9">26</td></tr>
<tr><td>3030</td></tr>
<tr><td>3070</td></tr>
<tr><td>3170</td><td rowspan="15">24</td></tr>
<tr><td>3220</td></tr>
<tr><td>3265</td><td rowspan="17">32</td></tr>
<tr><td>3310</td><td rowspan="11">26</td></tr>
<tr><td>3355</td></tr>
<tr><td>3400</td></tr>
<tr><td>3445</td><td rowspan="13">30</td><td rowspan="12">28</td></tr>
<tr><td>3490</td></tr>
<tr><td>3535</td></tr>
<tr><td>3630</td></tr>
<tr><td>3680</td></tr>
<tr><td>3725</td></tr>
<tr><td>3770</td></tr>
<tr><td>3815</td></tr>
<tr><td>3860</td><td rowspan="5">28</td></tr>
<tr><td>3905</td><td rowspan="4">26</td></tr>
<tr><td>3950</td></tr>
<tr><td>3995</td></tr>
<tr><td>4040</td><td>30</td></tr>
</table>

NOTE: Shaded Area indicates acceptable applications for Single Wall Metal Vent of the same diameter as Type B vent. Otherwise, Single Wall Metal Vent is not recommended.

2 - 8 2 - 8

FIGURE 2-13 (CONT')

Least Total Vent Height H	Connector Rise F	805H		806H		807HE		808HE		809HE		820HE	
		DW	SW	DW	SW	DW	SW	DW	SW	DW	SW	DW	SW
6	1	10	10	12	NR	NR	NR	12	NR	NR	NR	NR	NR
	2	9	9	10	10	10	10	12	NR	12	NR	14	NR
	3	9	9	10	9	10	10	12	NR	NR	NR	14	NR
	4	NR	NR	NR	NR	NR	NR	NR	NR	12	NR	12	NR
	6	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
8	1	10	10	12	NR	12	NR	NR	NR	NR	NR	NR	NR
	2	9	9	10	10	10	10	12	NR	12	NR	12	NR
	3	8	8	8	9	10	10	12	NR	12	NR	12	NR
	4	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
	6	NR	NR	NR	NR	12	NR	12	NR	12	NR	NR	NR
10	1	9	9	12	10	12	NR	NR	NR	NR	NR	NR	NR
	2	9	9	10	10	10	10	12	NR	12	NR	12	NR
	3	8	8	9	9	10	10	10	10	12	NR	12	NR
	4	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
	6	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
15	1	9	9	10	10	12	NR	NR	NR	NR	NR	NR	NR
	2	8	9	9	9	10	10	12	NR	12	NR	12	NR
	3	8	8	9	9	10	10	10	10	12	NR	12	NR
	4	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
	6	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
20	1	9	9	10	10	10	NR	NR	NR	NR	NR	NR	NR
	2	8	8	9	9	10	10	12	NR	12	NR	12	NR
	3	8	8	9	9	10	10	10	10	10	NR	12	NR
	4	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
	6	NR	NR	NR	NR	12	NR	12	NR	12	NR	12	NR
30	1	9	9	10	10	10	10	NR	NR	NR	NR	NR	NR
	2	8	8	9	9	9	9	12	10	12	NR	12	NR
	3	8	8	8	9	9	9	10	10	10	NR	12	NR
	4	NR	NR	NR	NR	NR	NR	12	NR	12	NR	12	NR
	6	NR	NR	NR	NR	NR	NR	12	NR	12	NR	12	NR
40	1	9	9	9	10	10	10	NR	NR	NR	NR	NR	NR
	2	8	8	9	9	9	9	10	10	12	NR	12	NR
	3	7	8	9	8	9	9	10	10	12	NR	12	NR
	4	NR	NR	NR	NR	NR	NR	12	NR	12	NR	12	NR
	6	NR	NR	NR	NR	NR	NR	12	NR	12	NR	12	NR

DW = Double Wall SW = Single Wall

2 - 8 2 - 8

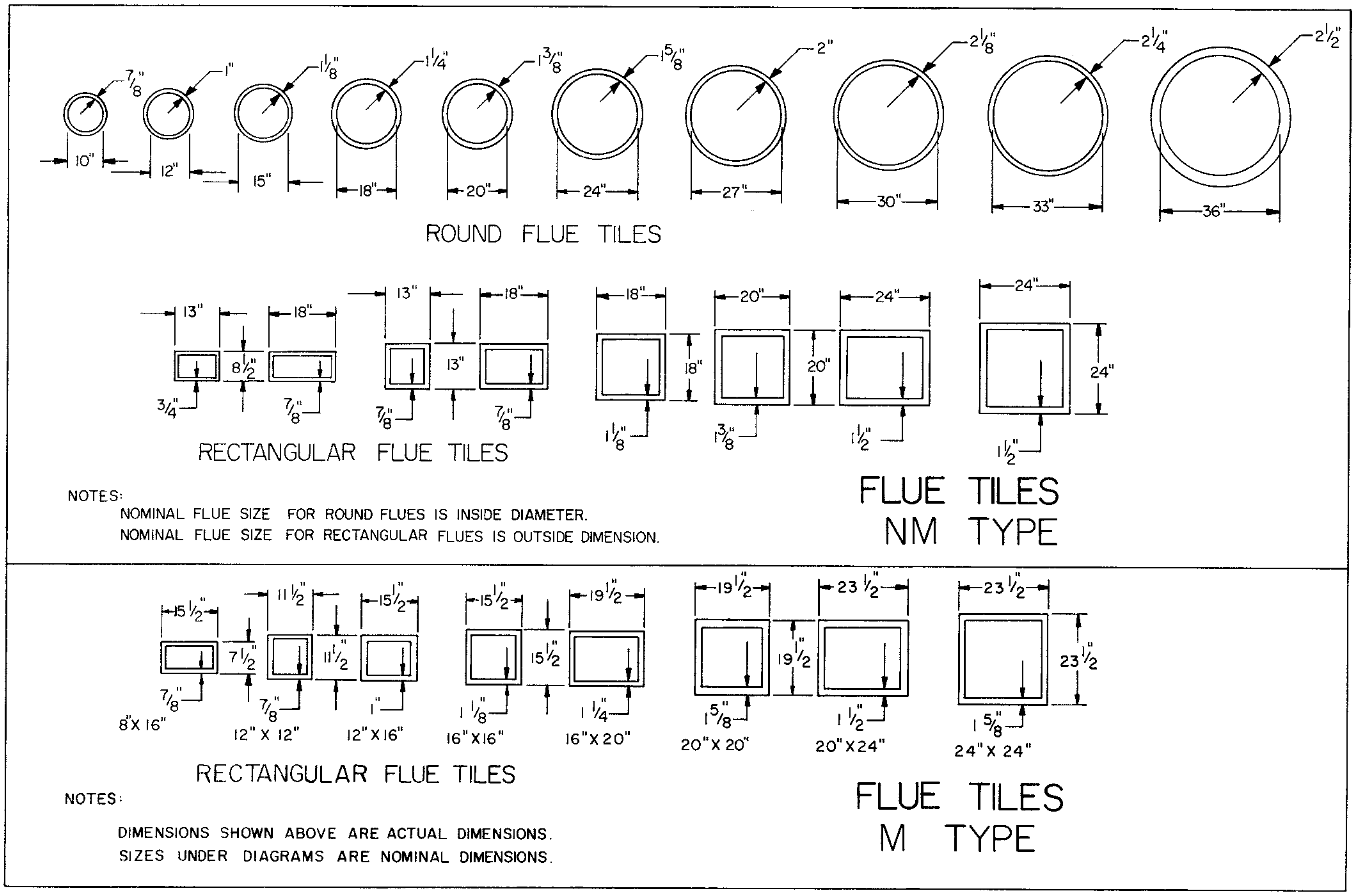
FIGURE 2-14

1 - 8 1 - 8

Individual Vent Dia. From Figure 2-8 or Common Vent Dia. CV - From Figure 2-9	Inside Area - Sq. In. Tile Lined Masonry Chimney
6	34.
7	46.
8	60.
10	94.
12	136.
14	185.
16	241.
18	305.
20	377.
22	452.
24	531.
26	616.
28	707.
30	804.
32	907.

1 - 8 1 - 8

FIGURE 2-15



NM TYPE FLUE TILES										
COMMON VENT	NOMINAL DIMENSIONS									
ROUND TILES	10" DIA.	12" DIA.	15" DIA.	18" DIA.	20" DIA.	24" DIA.	27" DIA.	30" DIA	33" DIA.	36" DIA.
AREA	74.5 SQ."	108 SQ."	171 SQ."	240 SQ."	298 SQ."	433 SQ."	551 SQ."	683 SQ."	829 SQ."	989.5 SQ."
RECTANGULAR TILES	8 1/2" X 13"	8 1/2" X 18"	13" X 13"	13" X 18"	18" X 18"	20" X 20"	20" X 24"	24" X 24"		
AREA	78.57 SQ."	107.75 SQ."	124.63 SQ."	168 SQ."	232 SQ."	279 SQ."	337.5 SQ."	420 SQ."		

NOTE:
ALL FLUE AREAS SHOWN ARE MINIMUM NET INSIDE AREAS.

M TYPE FLUE TILES										
COMMON VENT	NOMINAL DIMENSIONS									
RECTANGULAR TILES	8" X 16"	12" X 12"	12" X 16"	16" X 16"	16" X 20"	20" X 20"	20" X 24"	24" X 24"		
AREA	74 SQ."	87 SQ"	120 SQ."	162 SQ."	208 SQ."	262 SQ."	320 SQ."	385 SQ."		

AREA OF TYPICAL MASONRY FLUE TILES

FIGURE 2-16

SECTION 3.0 WATER PIPING

⚠WARNING

Burnham Commercial recommends maintaining temperature differential (drop) across the system at 40°F or less and return water temperature at minimum of 135°F.

CONTINUED BOILER OPERATION FOR PROLONGED PERIODS OF TIME UNDER CONDITIONS WHEN TEMPERATURE DIFFERENTIAL ACROSS THE SYSTEM EXCEEDS 40°F AND/OR RETURN WATER TEMPERATURE STAYS BELOW 135°F, MAY RESULT IN PREMATURE BOILER FAILURE DUE TO FLUE GAS CONDENSATION AND/OR THERMAL SHOCK.

IF THE ABOVE CONDITIONS EXIST, TO PROTECT A BOILER FROM SUSTAINED FLUE GAS CONDENSATION AND/OR THERMAL SHOCK, THE ABOVE-RECOMMENDED TEMPERATURES MAY BE MAINTAINED BY EMPLOYING COMMON INDUSTRY-ACCEPTED MIXING METHODS TO PROVIDE BOILER PROTECTION.

Some common methods are boiler by-pass piping, blend pumps, primary secondary piping with a by-pass, mixing valves and/or variable speed injection pumps.

⚠WARNING

Pressure relief valve discharge piping must be piped such that the potential of severe burns is eliminated. DO NOT pipe in any area where freezing could occur. DO NOT install any shut off valves, plugs or caps. Consult Local Codes for proper discharge piping arrangement.

3.1 Breeching ducts are generally less flexible in design location than are water pipes. To avoid conflicts for a given location, design and layout the breeching ducts before proceeding with water piping in this section.

3.1.1 The purpose of the Section 3.0 is to recommend piping systems and accessories that can be used with Series 8H/8HE Modular Gas Boilers. Although recommended design procedures are presented, the final sizing of mains, pumps and compression tank must be left to the designer of the total system because only that designer has available the requirements and capacities of the connected system.

3.1.2 Please consider the serviceman who must periodically clean and adjust the boilers and repair accessories. Do not block passageways with piping. Do not block access panels on the boiler jackets.

3.2 MANIFOLDS—Selection of the proper manifolds is important to the success of the modular concept. One of the prime reasons for using modular boilers instead of a single large boiler is to improve the seasonal fuel efficiency. Boiler losses are highest when the burner is off and the boiler is still warm. Thus, if one small module can carry the heating load during mild outdoor weather by nearly continuous firing, a significant loss can be prevented and greater utilization of fuel can be made. However, poor selection of manifolding can wipe out part or all of the potential fuel savings of the modular system. Some provision should be made to prevent water from flowing through any module when it is not being fired. When warm system water is allowed to flow through any unfired module, heat is being wasted by convection through the chimney and jacket of that unfired module. For example, on an eight module system fired by an eight step sequencer, only one module may be required to meet the connected load demand on a day that is 55°F outdoors. That would be a highly efficient operation. However, if the system water is allowed to flow through the other seven modules, they too are kept warm and the total jacket and flue losses of the eight modules may be as great as that of a single large boiler. Thus, intended benefit is lost.

Recommended Water Quality Requirements

pH: 8.3 - 10.5

TDS: < 3500 ppm

Total alkalinity ppm as $CaCO_3$: < 1200

Total copper ppm: < .05

Oily matter ppm: < -1

Total harness ppm: < -3

Chlorides: < 50 ppm

3.2.1 Figure 3-1 shows a typical parallel pumping system. Parallel pumping of modules does not prevent flow through unfired modules as commonly installed. Thus, parallel pumping is not desirable unless a motorized valve is used on the supply pipe from each module and controlled to open only when that module is fired. With motorized valves, the owner may find objectionable noise from high velocity water flow under light loads when the entire flow of the system pump is directed through only one module of the group.

3.2.2 By contrast, primary-secondary pumping provides positive flow through each module only when that module is fired. Figure 3-2 shows such a system. The piping is simple and uses only a single header made up of fabricated steel manifolds available as optional equipment. By keeping the head above the top of the modules as shown in Figure 3-2, any gravity circulation from header to unfired modules is prevented. Flow through each fired module is balanced as a result of having its own secondary circulator.

3.2.3 Primary-secondary pumping is preferred as it does accomplish the desired fuel economy. To get the same economy from parallel pumping it is necessary to install some mechanism which will prevent flow through unfired modules as well as to install separate supply and return headers. Thus, the total installed cost of primary-secondary pumping may not be more than that of a properly controlled parallel pumping system.

3.2.4 If after careful consideration, the system designer decides to use parallel pumping, a system using reverse return headers as shown in Figure 3-1 is recommended. Direct return headers are not recommended because direct returns are inherently unbalanced and may prevent some modules from delivering their rated capacities.

3.2.5 Optional fabricated manifolds are available as a convenience to the installer and are highly recommended with four or more modules.

3.2.5.1 Factory fabricated manifolds are lightweight and quite forgiving of minor piping misalignments common to multiple boiler installations. Each end of the 4" manifold is ready for connection to another manifold section or to the field piping by means of: 1. optional self-restrained pipe couplings, or 2. field roll-grooving for use of groove style couplings. One lateral connection on each manifold is threaded and intended to be made-up first to positively locate the manifold during its installation. The other lateral connections on each manifold are longer also threaded for those installations where threaded fittings, such as unions, are desired, but it is recommended that these longer threaded laterals be cut off to yield plain ends for applying the same style couplings as on the 4" ends.

3.2.5.2 The lateral connections on the factory fabricated manifolds for use with 805H, 806H, and 807HE modules are 1½" schedule 40, equally spaced on 28½" centers. The lateral connections on the factory fabricated manifolds for use with 808HE, 809HE, and 810HE modules are 2" schedule 40, equally spaced on 40" centers. If an 807HE and an 808HE module are to be connected to a common manifold, use the longer manifold with 40" spacing.

3.2.5.3 Manifolds are available to serve two or three modules. Two-module manifolds have two return and two supply lateral connections, three-module manifolds have three of each.

3.2.5.4 The manifolds are adaptable to parallel pumping applications by capping half of the lateral connections and using two manifolds: one for supply and one for return. Refer to Figure 3-1.

3.2.5.5 A fundamental advantage of primary-secondary pumping over parallel pumping is that water temperature rise and flow rate thru each module in a primary-secondary system is independent of the system temperature drop and flow rate. Hence, module piping to and from the manifold and the module circulators on a primary-secondary application may be based on a higher temperature rise thru the module, say 30° or 40°F, and downsized from the lateral connections. The module piping, valves, and circulator for primary-secondary pumping may be sized from the data in Figure 3-4.

3.2.5.6 For parallel pumping applications module piping should equal the lateral connection sizes. Refer to Figure 3-4 for module flow rates and pressure drop.

3.2.5.7 The maximum flow capacity of the factory fabricated manifold is 265.GPM. If the system is based on a 20°F ΔT, these manifolds could serve modules with a total input of 3400.MBH. If the system is based on ad 30°F ΔT, these manifolds could serve modules with a total input of up to 5100.MBH.

3.2.5.8 If the optional flex couplings shown in Figures 3-1 through 3-3 are to be used, they should be installed according to the instructions in section 3.16.

3.2.5.9 If groove style couplings are to be used, they should be installed according to the instructions in section 3.17.

3.2.6 On fewer than four modules, the designer may elect to use commercial schedule 40 pipe and fittings of a smaller size than the 4" pipe size of the fabricated manifolds. Refer to 3.4.1 for the procedure used to size a field fabricated manifold. It should be noted that in the case of primary-secondary pumping the return line to each module should not be down stream of the supply line from that same module to avoid short circuiting of heated water within that module.

3.2.7 On a scaled drawing of the boiler room, layout the selected water manifolds and mains.

3.3 STOP VALVES—Another prime reason for using modular boilers is that of servicing without shutting down the entire system. Any individual module can be shut down for cleaning or repairs without interrupting the operation of the remaining modules. This is true of electrical components and the gas components because most codes require a service shut off at each module. A mistake is often made by not installing water stop valves at the headers for each module. By installing stop valves at the headers for each module it becomes easy to perform repairs to the water side of the module, such as leaky fittings, control wells, and pumps. Without stop valves each such service call results in the aggravation of a system shut down. In addition, it takes time for the serviceman to drain before the repairs and then refill and vent the system after the repairs. That additional service time may cost the owner more over the life of the system than the cost of the stop valves at the time of installation. Finally, the use of water side stop valves on each module is required by some codes in order to exclude the header and inter-connecting water piping from consideration as an integral part of a boiler. Stop valves are recommended as shown in Figures 3-1 through 3-3.

3.4 TEMPERATURE DROP—Selection of temperature drop has received attention in recent years as a means of reducing piping or pumping costs. Over several previous decades the 20°F water temperature drop had been standard for the hydronics industry. Recently, temperature drops of 30°F, 40°F and even 50°F have been used successfully when the distribution system and terminal units are properly sized for these larger temperature drops. In new construction it is advisable to consider the savings in materials that can be made by designing with a temperature drop larger than 20°F.

3.4.1 Figure 3-5 is a typical friction-velocity-flow diagram used by most designers of large systems. The lower scale, Heat Conveyed, is based on a 20°F temperature drop. However, the flow rate in gpm is shown on the upper scale, and can be used to size pipe at other temperature drops by converting heat conveyed to flow rate in gpm.

Example: Find the pipe size required to convey 1,000,000 Btuh in iron pipe at a friction loss of 500 mill inches/ft. and temperature drops of 20°F, 30°F or 40°F.

Solution: The gpm flow rate for 1,000,000 Btuh is found by dividing:

1,000,000 by (500 x 20) = 100 gpm for 20° drop
1,000,000 by (500 x 30) = 66.7 gpm for 30° drop
1,000,000 by (500 x 40) = 50 gpm or 40° drop

Enter Figure 3-5 on the horizontal line for 500 mill inches per ft. and read across to the right to the vertical lines for 100 gpm, 66.7 gpm and 50 gpm.

On the slanted lines read the corresponding pipe sizes (use the larger if between two pipe sizes)

100 gpm = 3” Pipe
66.7 gpm = 2½” Pipe
50 gpm = 2½” Pipe

Figure 3-6 can be used in a similar manner for copper pipe.

3.4.2 The size of the terminal units (baseboard, convectors, fan coils, etc.) must be adjusted according to the actual temperature of water flowing in those units. In general, the first terminal unit on a circuit will receive hotter than average water and should be undersized, and the last terminal unit will receive cooler than average water and should be oversized. The designer should consult a sizing procedure such as that contained in the ASHRAE Guide or I=B=R Guide #250.

3.4.3 It should be noted that the selection of system temperature drop has no effect on the sizing of the boiler.

3.4.4 On remodeling jobs it is generally too expensive to modify the terminal units for temperature drops other than that used by the original system designer. It is not “safe” to assume that the original design was based on 20°F drop and thus the owner’s records should be consulted.

3.5 MAIN PIPING—Selection of Main Size and the system pump must go together. The system designer can select the pump and size the pipe accordingly, but more often the best economics of pipe and pump causes the system designer to select the minimum pipe size based on a maximum pressure drop and then select a pump(s) to meet flow and pressure drop requirements of the total system. It is recommended that pipe sizes be selected in the unshaded portions of Figure 3-5 or 3-6. The minimum pipe size will occur on or close to the upper limit of the unshaded areas.

Example: Find the minimum main size and corresponding friction for three 808HE modules using iron pipe and a 20°F temperature drop.

Solution:

1) The output of three 808HE modules is 3 x 410 x .80 = 984 MBH. Refer to Figure 2-3 for module input and Figure 2-1 for input to output multiplier.
2) Enter Figure 3-5 on the lower horizontal scale at 984 MBH and move vertically to the upper limit of the unshaded area.
3) On the lines that slant upward to the right, read the pipe size. In this case, the pipe size is greater than 2½” but less than 3”. Select the larger of 3”.
4) From the point in 2) above move down vertically to the 3” pipe line and horizontally to the left hand scale. Pick off 300 mill inches per foot friction.

3.5.1 In calculating the total equivalent length of pipe it is necessary to consider the additional resistance of elbows. Figure 3-7 shows the equivalent lengths. The total equivalent length of pipe in a circuit is the measured length plus the equivalent length of all elbows in that circuit. The total equivalent length of the longest circuit in the system is useful in determining the head requirement of the system pump.

3.6 COMPRESSION TANK—Selection of the compression tank must be based on the following items:

a) volume of water in the system
b) initial fill pressure of the system
c) maximum operating pressure of the system
d) maximum operating temperature of the system

3.6.1 It is necessary to calculate the volume of water contained in the total system including piping, modules and terminal units. Figure 3-8 can be used to determine the volume of the piping by measuring the length of each size of pipe and multiplying by the appropriate factor from Figure 3-8.

Example: Find the water volume in the piping of a system having 40’ of 3” pipe, 72’ of 2” pipe, and 52’ of 1¼” pipe.

Solution: From Figure 3-8 obtain the gallons/ft. from each size of pipe and multiply by the length of that size of pipe.

1¼” Copper = .065 gal/ft x 52 Ft = 3.4 Gal.
+ 2” Copper = .161 gal/ft x 72 Ft = 11.6 Gal.
+ 3” Copper = .357 gal/ft x 40 Ft = 14.3 Gal.
Total volume in piping = 29.3 Gal.

3.6.1.1 Use Figure 3-13 to calculate the volume of the modules.

Example: Find the volume of water in four 806H modules.

Solution: From Figure 3-13 find that the water volume of one 806H is 13.9 gallons and multiply by the number of modules:

13.9 x 4 = 55.6 gallons in the modules.

3.6.1.2 The water side of terminal units must be known in order to determine their volume. Tubular units such as baseboard, commercial finned tube, convectors and fan coils can be computed by knowing the length and size of the tubes.

Example: Find the water volume in 528 ft. of 1¼" copper dual tiered commercial finned tube.

Solution: From Figure 3-8 obtain the value of .065 gal/ft. for 1¼" copper and multiply by 528 ft. and by 2 tiers:

0.65 gal/ft x 528 ft x 2 tiers = 68.6 Gallons in the Finned Tube.

3.6.1.3 From the above examples the total volume of the system can be added:

Volume of piping	= 29.3 Gal.
+ Volume of modules	= 55.6 Gal.
+ Volume of Finned Tube	= 68.6 Gal.
Total Volume of System	= 153.5 Gal.

3.6.2 Conventional compression tanks can be sized by using Figures 3-9 and 3-10. Enter Figure 3-9 in the left hand column at the water volume of the system, move across to the right to the maximum water temperature of the system and read the uncorrected tank size.

To find the correction factor, enter Figure 3-10 in the left hand column of the initial fill pressure and move across to the right to column for the system pressure increase and read the tank correction factor. Multiply the uncorrected tank size by the correction factor to find the final tank size.

Example: Find the conventional compression tank size for a system having a water volume of 153.5 gallons, a design water temperature of 240°F, a 50 psi relief valve and a system height of 30 Ft.

Solution:

1) Enter Figure 3-9 in the left hand column and move down to 200 gallons (which is the next largest value to 153.5 gallons). Read across to the column for 240 design water temperature and read 38 gallons uncorrected tank size.
2) Find the initial fill pressure by multiplying the system height by 0.433:
   30 x 0.433 = 13 psi
3) Enter Figure 3-10 in the left hand column and move down to 12 psi fill pressure (closest to 13 psi). Move across to the column headed 40 psi pressure increase (closest column to 40 psi minus 13 psi) and read a correction factor of 0.63
4) Multiply 0.63 x 38 Gal. = 24 gallons corrected tank size.
5) Select a conventional compression tank size of at least 24 gallons. In some cases, greater accuracy may be obtained by interpolation in Figures 3-9 and 3-10.

3.6.3 Diaphragm type compression tanks can be sized by using Figures 3-11 and 3-12. Find the expansion factor for water at the design water temperature from Figure 3-11. Multiply that expansion factor by the volume of the system to obtain the acceptance volume of the compression tank.

Find the tank volume by dividing the acceptance volume by the acceptance factor from Figure 3-12.

Example: find the diaphragm type tank size for the same system as in 3.6.2 above.

Solution:

1) From Figure 3-11 at 240°F design temperature read an expansion factor of .0518.
2) Multiply the system volume by the expansion factor:
   Acceptance volume = 153.5 Gal x .0518 = 8 gallons
3) Enter figure 3-12 at a fill pressure of 13 psi and a final pressure of 50 psi and read the acceptance factor of 0.58.
4) Tank volume = 8 gallons ‘ 0.58 = 14 gallons
5) Select a diaphragm type tank having a minimum acceptance volume of 8 gallons and a tank volume of at least 14 gallons.

3.7 LOW WATER CUTOFF—On each modular installation at least one low water cutoff is required. If, as recommended in 3.3, modules are installed with shutoff valves in their respective supply and return piping to the manifold then each module will require a dedicated LWCO. Otherwise, a system LWCO will be required.

3.7.1 If a system LWCO is to be used, such as shown in Figure 3-1 or 3-2, it must be installed on the return main at an elevation higher than the modules and fill valve. The pipes connecting from the main to the system LWCO must be teed into the return main using the shortest possible 1" pipe and fewest fittings. See Figure 3-1 or 3-2. Do not install valves between the return main and the system LWCO. If for any reason, the elevation of a module is different from another module in the group, the system LWCO must be installed above the module having the highest elevation.

3.7.2 If dedicated LWCO's are to be used they must be installed between each module and its respective shutoff valve and at an elevation higher than the module and its fill valve. A probe style LWCO is available as an option and its recommended installation location is in the module's supply riser to the manifold as depicted in Figures 3-2 and 3-3. Do not install any valve between the module and its respective LWCO.

3.8 RELIEF VALVE—Each Series 8H/8HE module is supplied with its own pressure relief valve. No additional relief valves need be installed on the manifolds. If domestic water heating is added to a module, it is recommended that a relief valve be installed as shown in Figure 3-14.

3.9 LIMIT CONTROL—Each Series 8H/8HE module is supplied with its own high limit control. To meet ASME requirements, a second operating control must be placed in the supply header downstream of the last module but upstream of any valve on the supply main. The size and type of control well will depend on the control system selected in Section 5.0. Note: The local jurisdiction may require that the high limit on the module be of the manual reset type.

3.10 PRESSURE & TEMPERATURE GAUGE—Each Series 8H/8HE module is supplied with its own Tridicator so that the performance of each module can be observed without installation of additional gauges.

3.11 FILL VALVE—An automatic fill valve is recommended to maintain the minimum pressure in the system at the fill pressure required by the height of the piping system.

3.12 SYSTEM CIRCULATOR—To avoid placing the head pressure of the system circulator on the boiler and compression tank, the system circulator should be installed such that it pumps away from the boiler and compression tank. See Figures 3-1 and 3-2.

3.13 DOMESTIC WATER HEATING—An external water heater may be added to any module on either primary-secondary or parallel circulation system. If heavy water heating loads are anticipated an additional module(s) may be added to the water heating circuit. Refer to Figure 3-14 for recommended module water piping for domestic water heating, with parallel piping. Refer to Figure 3-3 for recommended pipng when using an Alliance Indirect hot water tank with Primary Secondary Piping.

3.13.1 Water heater size may be determined in the following manner:

1) From Figure 3-15, find the appropriate factor for each fixture in the building and add them together to find the total fixture units.
2) From Figure 3-16, convert the fixture units to hot water capacity in gallons per minute based on 40-140°F temperature rise.
3) Select water heater based on gallons per minute from 2) above.

3.13.2 The addition of water heating may not necessarily add to the size of the modules. Since the maximum space heating lead and the maximum water heating load rarely occur at the same time, only a portion of the water heating load is added to the space heating load to size the modules as follows:

1) Calculate the water heating load in Btuh: __________gpm x 8.33 Lb/Gal x 60 Min/Hr x 100 ΔT = ___________Btuh
2) Calculate ratio = $\dfrac{\text{Water Heating Load}}{\text{Space Heating Load}}$
3) From Figure 3-17, using the ratio found in 2), find factor for sizing the "boiler added capacity".
4) Calculate "boiler added capacity" by multiplying factor from 3) by water heating load.
5) Total the space heating load and the "boiler added capacity", and convert this total load to total input by using the 1.44 multiplier from Figure 2-1.
6) Select modules from Figure 2-2 using this total input.
7) Convert the input of one module (found in Figure 2-3) to Gross Output by using the .80 multiplier from Figure 2-1.
8) Divide water heating load by gross output of one module to determine the number of modules to be used in the water heating circuit.

Example #1—An office building has 12 basins and 2 slop sinks and a space heating load of 1,403,500 Btuh. Size the water heater and boiler.

Solution:

1) 12 basins x ¾ units = 9 Fixture Units
+2 slop sinks x 1½ units = 3 Fixture Units
Total = 12 Fixture Units
2) In Figure 3-16, using curve "C" for office building, find that for 12 Fixture Units 6 gpm is required.
3) Select water heater at 6 gpm and 40-140°F temperature rise.
4) Calculate water heating load in Btu.
6 x 8.33 x 60 x 100 = 299,880 Btuh
5) Calculate ratio = $\dfrac{\text{Water Heating}}{\text{Space Heating}} = \dfrac{299{,}880}{1{,}403{,}500} = .22$
6) From Figure 3-17 find that for a ratio of less than .25 the boiler added capacity is 0%.
7) Convert the total load (1,403,500 + 0 Btuh) to total Input:
$\dfrac{1{,}403{,}500\text{ Btuh}}{1000\text{ Btuh/MBH}} \times 1.44 = 2{,}021$ MBH Input
8) Enter Figure 2-2 at 2,046 MBH Input (closest Input over 2,021 MBH) and select (4) 810HE modules as the most economical combination of modules.
9) Convert the Input of one module to Gross Output using Figures 2-1 and 2-3:
810HE
$505\text{ MBH} \times .80 \times \dfrac{1000\text{ Btuh}}{\text{MBH}}$
= 406,000 Btuh Gross Output

10) The water heating load of 299,880 Btuh could be handled by any one of the 810HE modules:
$\frac{299{,}880}{406{,}000}$ = (1) 810HE module

Example #2: an apartment building has 12 basins, 12 kitchen sinks, 14 showers, 12 dishwashers and 2 slop sinks. The design space heating load is 772,000 Btuh. Size the water heater and boiler.

Solution:

1) From Figure 2-15:

12 basins x ¾ units	= 9 Fixture Units
+ 12 sinks x ¾ units	= 9
+ 14 showers x 1½ units	= 21
+ 12 dishwashers x 1½ units	= 18
+ 2 slop sinks x 1½ units	= 3
Total Fixture Units	= 60

2) From figure 3-16 using curve "B" for apartment houses, find 27 gpm for 60 fixture units.
3) Select a water heater having a capacity of 27 gpm at 40-140° F temperature rise.
4) Calculate the water heater load: 27 x 8.33 x 60 x 100 = 1,349,500 Btuh
5) Calculate ratio = $\frac{\text{Water Heating}}{\text{Space Heating}}$
$= \frac{1{,}349{,}500}{772{,}000} = 1.75$
6) From Figure 3-17 and a ratio of 1.75 find factor of .84.
7) Net rating of boiler = .84 x 1,349,500 + 772,000 = 1,905,550 Btuh
8) Required modular Input =
$\frac{1{,}905{,}550 \text{ Btuh}}{1000 \text{ Btuh/MBH}} \times 1.44 = 2{,}744$ MBH Input
9) Module selection from Figure 2-2 is (6) 809HE modules.
10) Module Gross Output:
809HE
460 x .80 x 1000 = 368,000 Btuh
11) Number of modules in water-heating circuit:
$\frac{1{,}349{,}500}{368{,}000}$ = (4) 809HE modules

3.13.3 The domestic water heater sizing procedures outlined in this section are based on methods recommended in the ASHRAE HANDBOOK and Product Directory, Systems Volume, "Service Water Heating" Chapter.

3.14 PIPING MATERIAL supplied on a Series 8H/8HE packaged boiler, or in the water trim carton of a Series 8H/8HE knockdown, consists of the following:

Quantity	
1	Altitude Temperature & Pressure Gauge 2½" Dia., 60-320°F, 0-75 PSIG
1	¾" ASME Safety Relief Valve set at 50 PSI—ConBraCo or Watts
1	¾" Drain Cock
1	¾" Pipe Coupling—For Drain
1	2" x 10" Pipe Nipple—For Supply Piping
1	2" x ¾" x 2" Tee—For Supply Piping
1	¾" x ¼" Pipe Bushing—For Supply Piping
1	¾" x Close Pipe Nipple—Relief Valve Piping
1	¾" x 2" Pipe Nipple—Relief Valve Piping
2	¾" x 3½" Pipe Nipple—Relief Valve Piping and Drain
1	¾"—90° Ell—Relief Valve Piping
1	¾" Tee—Relief Valve Piping

3.15 Piping components recommended for primary-secondary pumping are depicted in Figure 3-3.

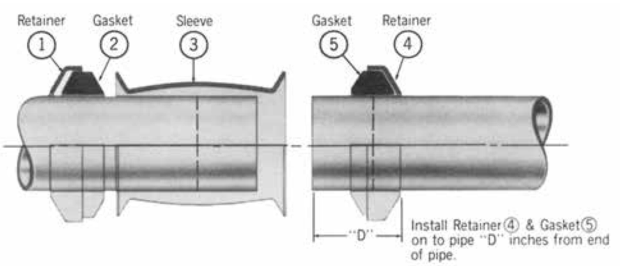
3.16 Installation procedure for optional flex couplings.

3.16.1 Pipe End Preparation

a) 4" ends of fabricated manifolds: with a manual or automatic pipe cutter, cut 1-1/8" off each end of the manifold to provide the proper gap between pipe ends.
b) 1½" or 2" laterals of fabricated manifolds: with a manual pipe cutter, cut 1½" off each of the 4" long laterals to remove the pipe threads. Do not cut the threads off the shorter 2½" long lateral, as this connection is intended to be piped rigid to locate the manifold during installation. If the manifold is to be used for parallel pumping, do not cut the threads off the laterals that are to be capped.
c) Deburr and clean pipe ends.
d) Special surface finish on pipe is not required. Surface to be free of deep scratches, gouges, dents, etc.

3.16.2 Joint Installation

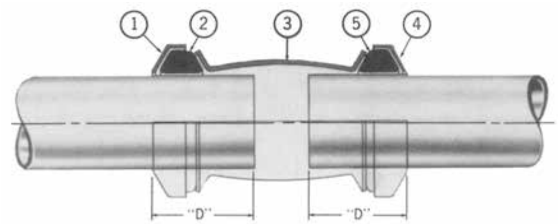
a) Install retainer (1), gasket (2) and sleeve (3) on one pipe end or manifold in sequence shown below.



b) Install remaining retainer (4) and gasket (5) on other pipe end or manifold.
c) Position retainer (4) and gasket (5) to proper pipe insertion depth "D":

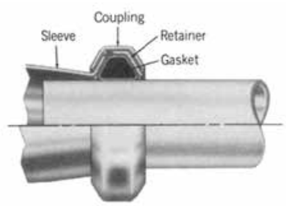
Pipe Size	Pipe Insertion Depth Nominal	Max.	Min.
1-1/2"	1-3/8"	1.62"	1.16"
2"	1-1/2"	1.84"	1.18"
4"	2-1/16"	2.44"	1.74"

d) Slide sleeve (3) to gasket (5) and move gasket (2) and retainer (1) into position as shown.
Pipe must be inserted to proper depth "D" into both gaskets.



3.16.3 Coupler Installation

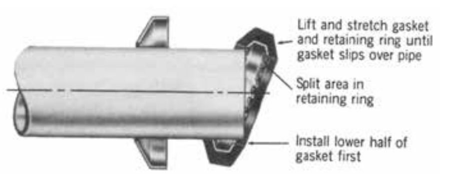
Install both V-couplings, encompassing the retainer, gasket and sleeve. Do not tighten either coupling until entire joint has been assembled. Tighten nuts of 4” couplings to 280-300 inch-lbs. and 1½” and 2” couplings to 140-160 inch-lbs., or to a minimum of 1/16” clearance between coupling lugs, whichever occurs first. Retightening of the coupler will be necessary if leakage occurs. A completed V-coupling installation is shown below.



3.16.4 Special Notes

a) Assembly of gaskets can be made easier by dipping gaskets in water or wiping them with a small amount of liquid hand soap. Other rubber lubricants cannot be used.

b) To simplify installation of the self-restrained gasket, install the lower half of the gasket first, leaving the split area in the steel retaining ring free at the top. Then, stretch the gasket and split area of the retaining ring until they slip over the pipe and into position as shown below.



c) These self-restrained joints are recommended for use on elbows and tees because they are capable of supporting end loads caused by internal pressure up to their rated operating pressure of 80 psi. Recommended assembly torque must be maintained to withstand these end loads.

d) The gaskets supplied with the flex couplings are specifically formulated for boiler water service (—20°F to 275°F) and are compatible with antifreeze and corrosion inhibitors. Use of other gasket materials is not recommended and may result in loss of seal!

3.16.5 Laying Length of Coupling

The axial spacing, or gap, between pipe ends joined by the optional flex couplings is variable within these limits:

Pipe Size	Laying Length (Gap)		
	Nominal	Max.	Min.
1-1/2"	3/4"	1-3/16"	1/4"
2"	1"	1-5/8"	3/8"
4"	2-3/8"	3"	1-3/4"

3.16.6 Misalignment

In addition to the axial misalignment tabulated in 3.16.5 the flex couplings permit a 4° angular installation misalignment at each end.

3.17 Installation notes for V-groove couplings.

3.17.1 Pipe End Preparation

a) 4" ends of fabricated manifolds: since the 4" pipe of the manifold is schedule 10, the ends should be roll-grooved. DO NOT cut-groove the 4" ends of the fabricated manifolds.

b) 1½" or 2" laterals of fabricated manifolds: with a manual pipe cutter, cut 1½" off each of the 4" long laterals to remove the pipe threads. Do not cut the threads off the shorter 2½" long lateral, as this connection is intended to be piped rigid to locate the manifold during installation. If the manifold is to be used for parallel pumping, do not cut the threads off the laterals that are to be capped. The laterals are schedule 40 so those intended for V-groove couplings may be roll-grooved or cut-grooved.

3.17.2 Gasket Material

Selection of a gasket material is of utmost importance! It must maintain a leak tight seal for many years at the temperatures and pressures of a hot water boiler and withstand the attack of the corrosion inhibitors and antifreezes common to hot water system. In general neoprene, nitrile, Buna-N, EPDM, and butyl are not acceptable gasket materials because they either are not resistant to the fluids or are not capable of continuous use at 250°F.

3.17.3 Gasket and Coupling Installation

Specific installation procedures vary from one coupling manufacturer to another. Follow the coupling manufacturer's recommendations for installation.

3.18 STRAINERS—A start-up strainer is recommended for practically all modular installations (new and replacement alike) to prevent system debris and sediment from ending up in the boilers where it will inhibit heat transfer and may eventually cause a cast iron section to crack from overheating.

3.19 OXYGEN CORROSION:

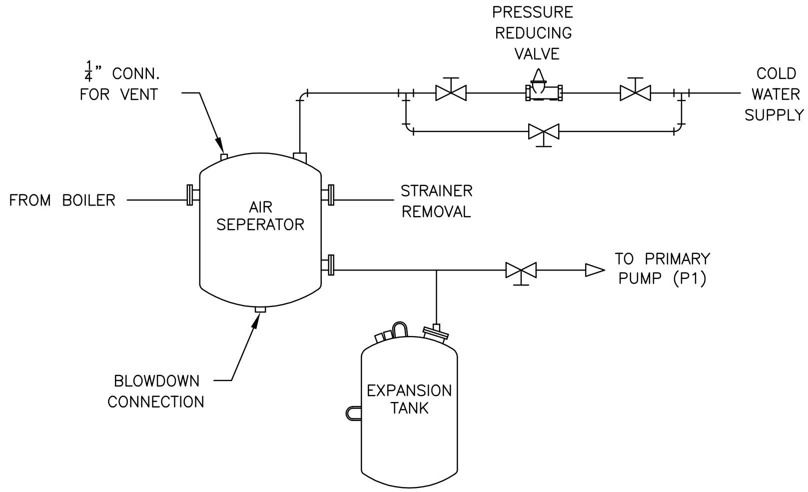
3.19.1 Oxygen contamination of the boiler water will cause corrosion of the iron and steel boiler components, which can lead to failure. As such, any system must be designed to prevent oxygen absorption in the first place or prevent it from reaching the boiler. Problems caused by oxygen contamination of boiler water are not covered by Burnham's standard warranty.

3.19.2 There are many possible causes of oxygen contamination such as:

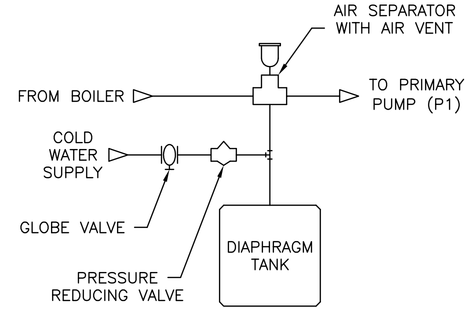
a. Addition of excessive make-up water as a result of system leaks.
b. Absorption through open tanks and fittings.
c. Oxygen permeable materials in the distribution system.

3.19.3 In order to insure long product life, oxygen sources should be eliminated. This can be accomplished by taking the following measures:

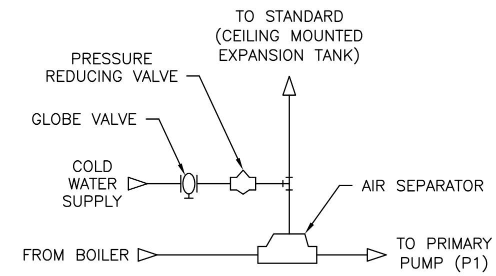
a. Repairing system leaks to eliminate the need for addition of make-up water.
b. Eliminating open tanks from the system.
c. Eliminating and/or repairing fittings which allow oxygen absorption.
d. Use of non-permeable materials in the distribution system.
e. Isolating the boiler from the system water by installing a heat exchanger.



AIR SEPERATOR TYPE SYSTEM



AIR REMOVAL SYSTEM

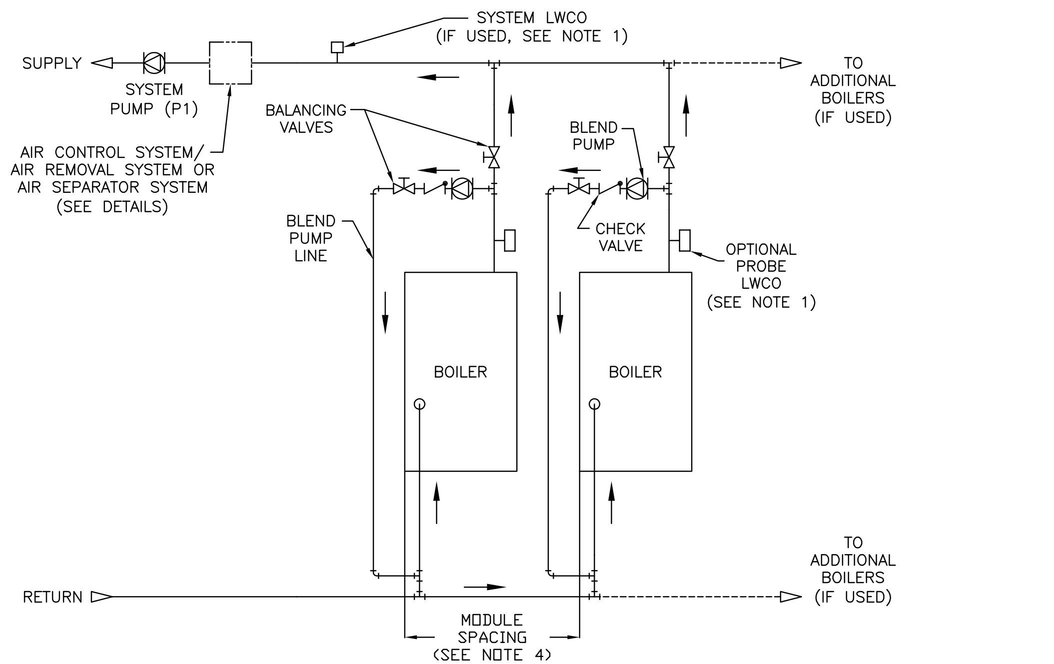


AIR CONTROL SYSTEM

BLEND PUMP SIZING INFORMATION					
BOILER MODEL	BOILER HP	GROSS OUTPUT (MBH)	BLEND PUMP FLOW (GPM) *	BLEND PUMP LINE SIZE	MIN BOILER SUPPY & RETURN PIPING (NPT)**
805H	6.1	208	3.1	3/4"	1-1/2"
806H	7.6	253	3.8	3/4"	2"
807HE	8.2	275	4.1	1"	2"
808HE	10.0	328	5.0	1"	2"
809HE	11.0	370	5.5	1"	2"
810HE	12.1	406	6.1	1"	2"

* USE 3 FT. OF HEAD FOR SELECTING BLEND PUMP

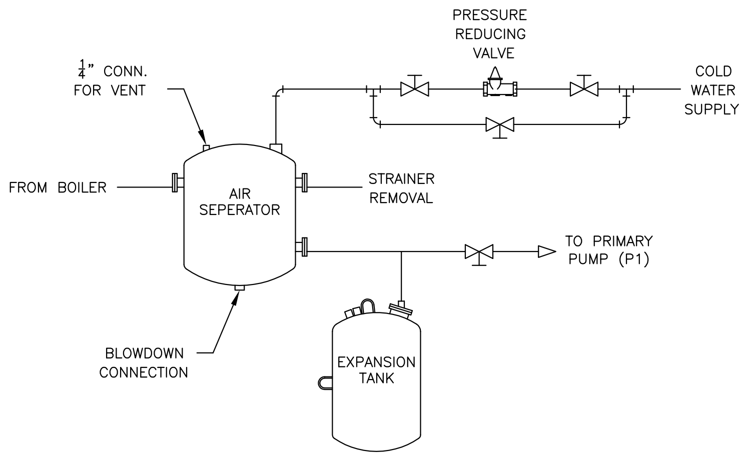
** BASED ON 20°F Δ T.



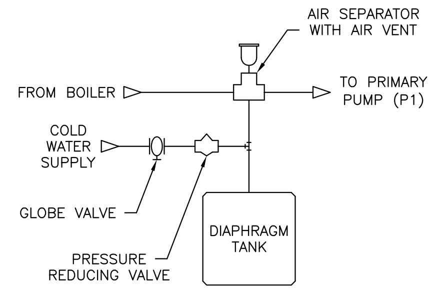
NOTES:
1. SYSTEM L.W.C.O. OR MODULE L.W.C.O. AS REQ'D. CONSULT LOCAL CODES.
2. DO NOT BLOCK PASSAGEWAYS OR ACCESS TOP AND FRONT JACKET PANELS.
3. FOR ALL BOILER PIPING REQUIREMENTS REFER TO LOCAL CODES.
4. MODULE SPACING FOR OPTIONAL MANIFOLDS (SEE FIG. 3-X FOR PIPING):
   805H, 806H, 807HE = 28 1/2"
   808HE, 809HE, 810HE = 40"

PIPING DIAGRAM (2 BOILERS), PARALLEL WITH BLEND PUMP AND SYSTEM PUMP

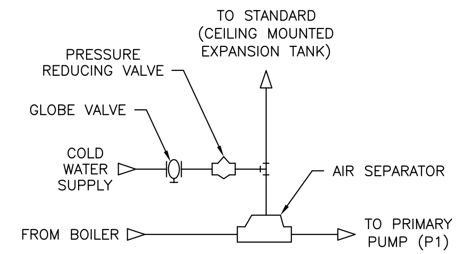
FIGURE 3-1



AIR SEPERATOR TYPE SYSTEM

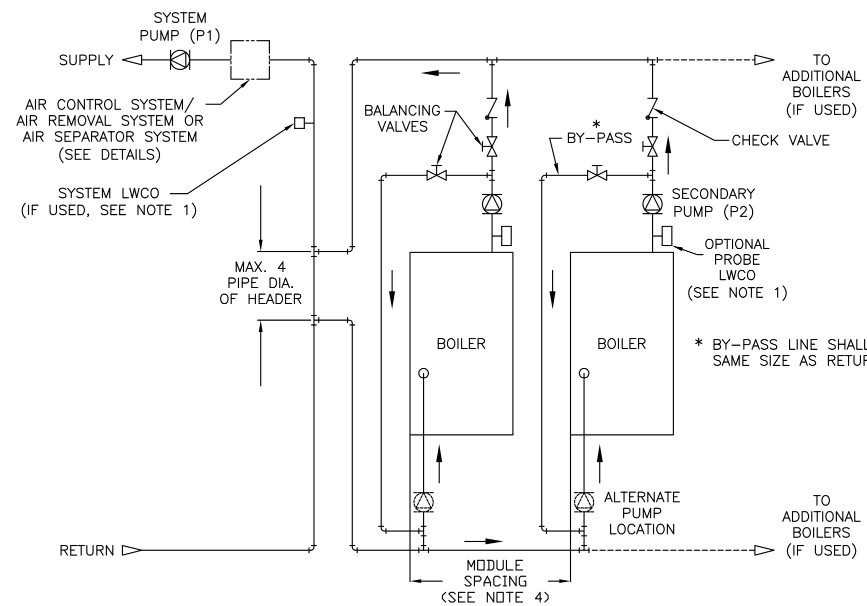


AIR REMOVAL SYSTEM



AIR CONTROL SYSTEM

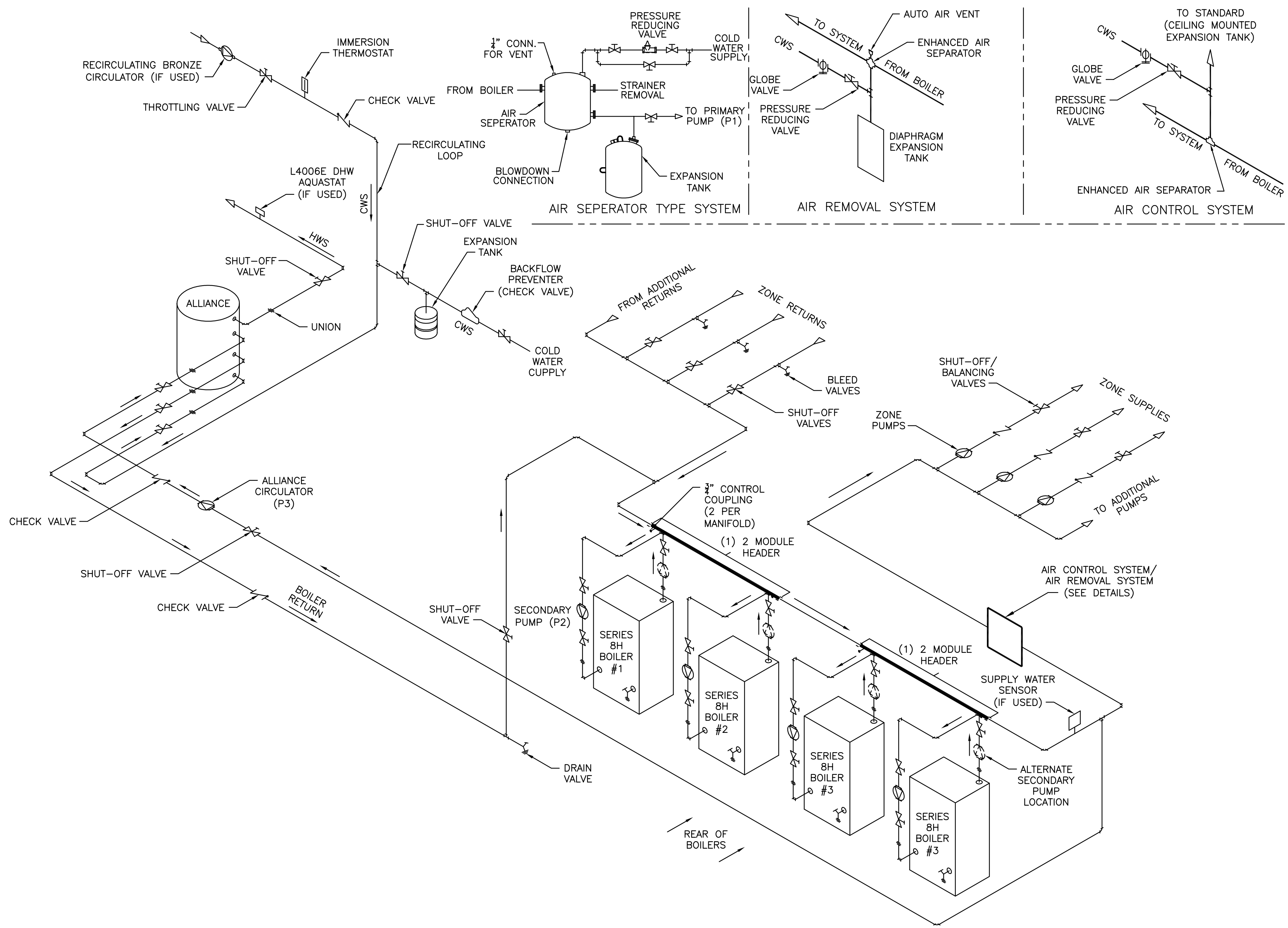
BOILER MODEL	SUPPLY RATE (GPM)	TEMP. RISE THRU BOILER	MIN. BOILER SUPPLY & RETURN PIPING (NPT)	BOILER PRESSURE DROP
805H	21	20°F	1½"	3'
	14	30°F	1¼"	2'
	11	40°F	1¼"	1'
806H	25	20°F	1½"	3'
	17	30°F	1½"	2'
	13	40°F	1¼"	1'
807HE	28	20°F	2"	3'
	18	30°F	1½"	2'
	14	40°F	1¼"	1'
808HE	33	20°F	2"	3'
	22	30°F	1½"	2'
	17	40°F	1½"	1'
809HE	37	20°F	2"	3'
	25	30°F	2"	2'
	19	40°F	1½"	1'
810HE	41	20°F	2"	3'
	27	30°F	2"	2'
	21	40°F	1½"	1'



NOTES:
1. SYSTEM L.W.C.O. OR MODULE L.W.C.O. AS REQ'D. CONSULT LOCAL CODES.
2. DO NOT BLOCK PASSAGEWAYS OR ACCESS TOP AND FRONT JACKET PANELS.
3. FOR ALL BOILER PIPING REQUIREMENTS REFER TO LOCAL CODES.
4. MODULE SPACING FOR OPTIONAL MANIFOLDS (SEE FIG. 3-X FOR PIPING):
   805H, 806H, 807HE = 28½"
   808HE, 809HE, 810HE = 40"

PIPING DIAGRAM (2 BOILERS), PRIMARY/SECONDARY WITH BY-PASS AND SYSTEM PUMP

FIGURE 3-2



PIPING DIAGRAM - ZONE PUMPS, PRIMARY/SECONDARY W/ ALLIANCE DHW & RECIRC. LOOP WITH MODULAR MANIFOLDS

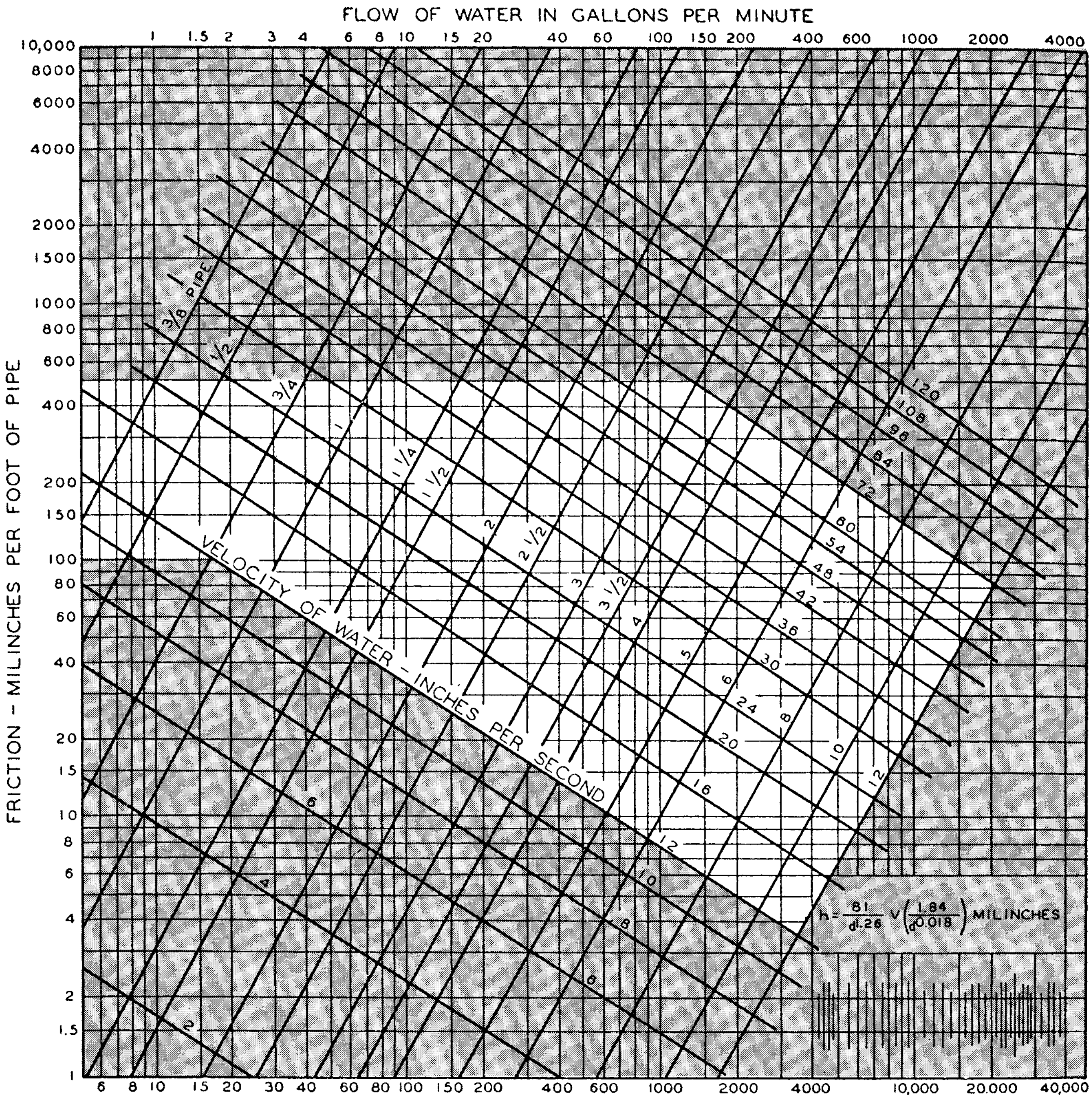
FIGURE 3-3

Module Size	Flow Rate (GPM)	Temp. Rise Thru Module	Min. Module Piping (NPT)	Module Pressure Drop
805H	21	20°F	1½"	3'
	14	30°F	1¼"	2'
	10	40°F	1¼"	1'
806H	25	20°F	1½"	3'
	17	30°F	1½"	2'
	13	40°F	1¼"	1'
807HE	28	20°F	2"	3'
	18	30°F	1½"	2'
	14	40°F	1¼"	1'
808HE	33	20°F	2"	3'
	22	30°F	1½"	3'
	17	40°F	1½"	2'
809HE	37	20°F	2"	3'
	25	30°F	2"	2'
	19	40°F	1½"	1'
810HE	41	20°F	2"	3'
	27	30°F	2"	2'
	21	40°F	1½"	1'

1) In a primary-secondary pumping installation temperature rise thru the module has no relation to system ΔT. In a parallel pumping installation temperature rise thru the module equals the temperature drop of the system.
2) In a primary-secondary pumping installation pressure drop thru the module does not add to system circulator head. In a parallel pumping installation pressure drop thru the module does add to system circulator head load.
3) 40°F Temperature rise thru module recommended for Primary-Secondary pumping.

MODULE WATER FLOW DATA

FIGURE 3-4

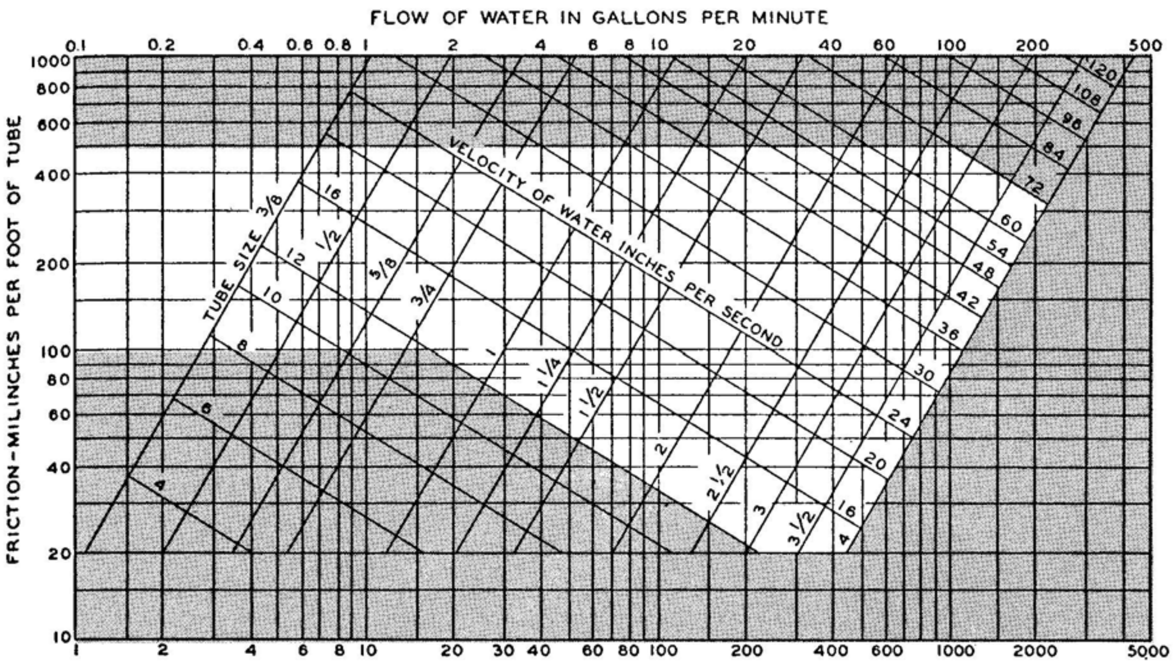


HEAT CONVEYED PER HOUR, MBH, WITH 20°F TEMPERATURE DROP

FRICTION VS WATER FLOW - IRON PIPE

TO USE THIS FIGURE: (1) ENTER HORIZONTAL SCALE AT DESIRED FLOW, (2) MOVE DOWN VERTICALLY TO UPPER LIMIT OF UNSHADED AREA, (3) PICK OFF MINIMUM PIPE SIZE ON DIAGONAL LINES SLOPING UPWARD TO THE RIGHT. (4) PICK OFF WATER VELOCITY ON DIAGONAL LINES SLOPING UPWARD TO THE LEFT.

FIGURE 3-5



HEAT CONVEYED PER HOUR, MBH, WITH 20°F TEMPERATURE DROP

FRICTION VS WATER FLOW - COPPER PIPE

To use this Figure: (1) Enter horizontal scale at desired flow. (2) Move down vertically to upper limit of unshaded area, (3) Pick off minimum pipe size on diagonal lines sloping upward to the right. (4) Pick off water velocity on diagonal lines sloping upward to the left.

FIGURE 3-6

Vol.	Pipe Size														
Fps	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12
1	1.2	1.7	2.2	3.0	3.5	4.5	5.4	6.7	7.7	8.6	10.5	12.2	15.4	18.7	22.2
2	1.4	1.9	2.5	3.3	3.9	5.1	6.0	7.5	8.6	9.5	11.7	13.7	17.3	20.8	24.8
3	1.5	2.0	2.7	3.6	4.2	5.4	6.4	8.0	9.2	10.2	12.5	14.6	18.4	22.3	26.5
4	1.5	2.1	2.8	3.7	4.4	5.6	6.7	8.3	9.6	10.6	13.1	15.2	19.2	23.2	27.6
5	1.6	2.2	2.9	3.9	4.5	5.9	7.0	8.7	10.0	11.1	13.6	15.8	19.8	24.2	28.8
6	1.7	2.3	3.0	4.0	4.7	6.0	7.2	8.9	10.3	11.4	14.0	16.3	20.5	24.9	29.6
7	1.7	2.3	3.0	4.1	4.8	6.2	7.4	9.1	10.5	11.7	14.3	16.7	21.0	25.5	30.3
8	1.7	2.4	3.1	4.2	4.9	6.3	7.5	9.3	10.8	11.9	14.6	17.1	21.5	26.1	31.0
9	1.8	2.4	3.2	4.3	5.0	6.4	7.7	9.5	11.0	12.2	14.9	17.4	21.9	26.6	31.6
10	1.8	2.5	3.2	4.3	5.1	6.5	7.8	9.7	11.2	12.4	15.2	17.7	22.2	27.0	32.0

EQUIVALENT LENGTH OF PIPE FOR 90° ELBOWS

To use this table: (1) Enter left hand column at desired water velocity, (2) Move horizontally to the right to the right to the column headed by the desired pipe size. (3) Read the equivalent length of pipe for each 90° elbow to be added to the measured length at the piping circuit.

FIGURE 3-7

Size	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12
Copper Tube	.012	.025	.043	.065	.092	.161	.250	.357	.625	1.00	1.40	2.43	3.78	5.40
Steel Pipe	.016	.028	.045	.078	.102	.172	.250	.385	.667	1.00	1.50	2.63	4.20	5.90

VOLUME OF WATER IN STEEL PIPE AND COPPER TUBE - GAL/FT

TO USE THIS TABLE: (1) ENTER LEFT HAND COLUMN AT DESIRED TYPE OF PIPE, (2) MOVE TO THE RIGHT TO THE DESIRED PIPE SIZE, (3) READ THE RESULTING GALLONS PER FOOT OF PIPE.

FIGURE 3-8

Water Vol. In Gallons	Mean Design Water Temperature °F						
	150°	160°	180°	200°	220°	240°	250°
10	0.6	0.8	1.0	1.3	1.6	1.9	2.0
20	1.2	1.7	2.0	2.6	3.2	3.8	4.1
30	1.8	2.5	3.0	4.0	4.8	5.7	6.1
40	2.4	3.3	4.0	5.3	6.4	7.6	8.2
50	3.0	4.2	5.0	6.6	8.0	9.5	10
60	3.6	5.0	6.0	7.9	9.7	11	12
70	4.2	5.8	7.0	9.2	11	13	14
80	4.7	6.7	8.0	11	13	15	16
90	5.3	7.5	9.0	12	14	17	18
100	5.9	8.0	10	13	15	19	20
200	12	17	20	26	32	38	41
300	18	25	30	40	48	57	61
400	24	33	40	53	64	76	82
500	30	42	50	66	80	95	102
600	36	50	60	79	97	114	122
700	42	58	70	92	113	133	143
800	47	67	80	110	129	150	163
900	53	75	90	120	145	170	184
1000	59	80	100	130	161	190	200
2000	120	170	200	260	320	380	410
3000	180	250	300	400	480	570	610
4000	240	330	400	530	640	760	820
5000	300	420	500	660	800	950	1020
6000	360	500	600	790	970	1140	1220
8000	470	670	800	1100	1290	1500	1630
10000	590	800	1000	1300	1610	1900	2000

COMPRESSION TANK SELECTION TABLE - CAPACITY IN GALLONS

To use this table: (1) Enter left hand column at water volume of the system, (2) Move to the right to the maximum water temperature of the system. (3) Read the uncorrected tank size, (4) Proceed to Figure 3-10.

FIGURE 3-9

Initial Pressure On Compression Tank	Allowable System Pressure Increase*											
	6 psi	8 psi	10 psi	12 psi	14 psi	16 psi	20 psi	25 psi	30 psi	40 psi	50 psi	75 psi
4 psi	1.0	.8	.68	.62	.59	.55	.5	.49	.48	.48	.48	.48
8 psi	1.6	1.2	1.05	.92	.85	.8	.7	.65	.6	.5	.5	.5
12 psi	2.0	1.7	1.43	1.25	1.15	1.07	.95	.8	.75	.63	.55	.54
18 psi	3.0	2.55	2.2	1.94	1.75	1.6	1.35	1.15	.98	.8	.72	.7
24 psi	4.6	3.65	3.1	2.65	2.38	2.15	1.78	1.52	1.35	1.12	1.02	1.0
30 psi	---	5.0	4.2	3.6	3.1	2.7	2.3	1.9	1.8	1.43	1.25	1.1
38 psi	---	---	5.3	4.6	4.1	3.7	3.05	2.5	2.25	1.95	1.7	1.4
50 psi	---	---	---	---	---	---	4.7	3.9	3.1	2.6	2.3	2.0
60 psi	---	---	---	---	---	---	---	4.5	3.8	3.1	2.7	2.4
70 psi	---	---	---	---	---	---	---	---	5.2	3.9	3.5	3.1

* Relief Valve setting minus initial pressure on Relief Valve, pump on.

CORRECTION FACTOR FOR COMPRESSION TANK SELECTION

To use this table: (1) Enter left hand column at initial pressure, (2) Move to the right to column headed with the allowable system pressure increase, (3) Read correction factor. (4) Multiply correction factor by the uncorrected tank size found from Figure 3-9 to obtain the corrected compression tank size.

FIGURE 3-10

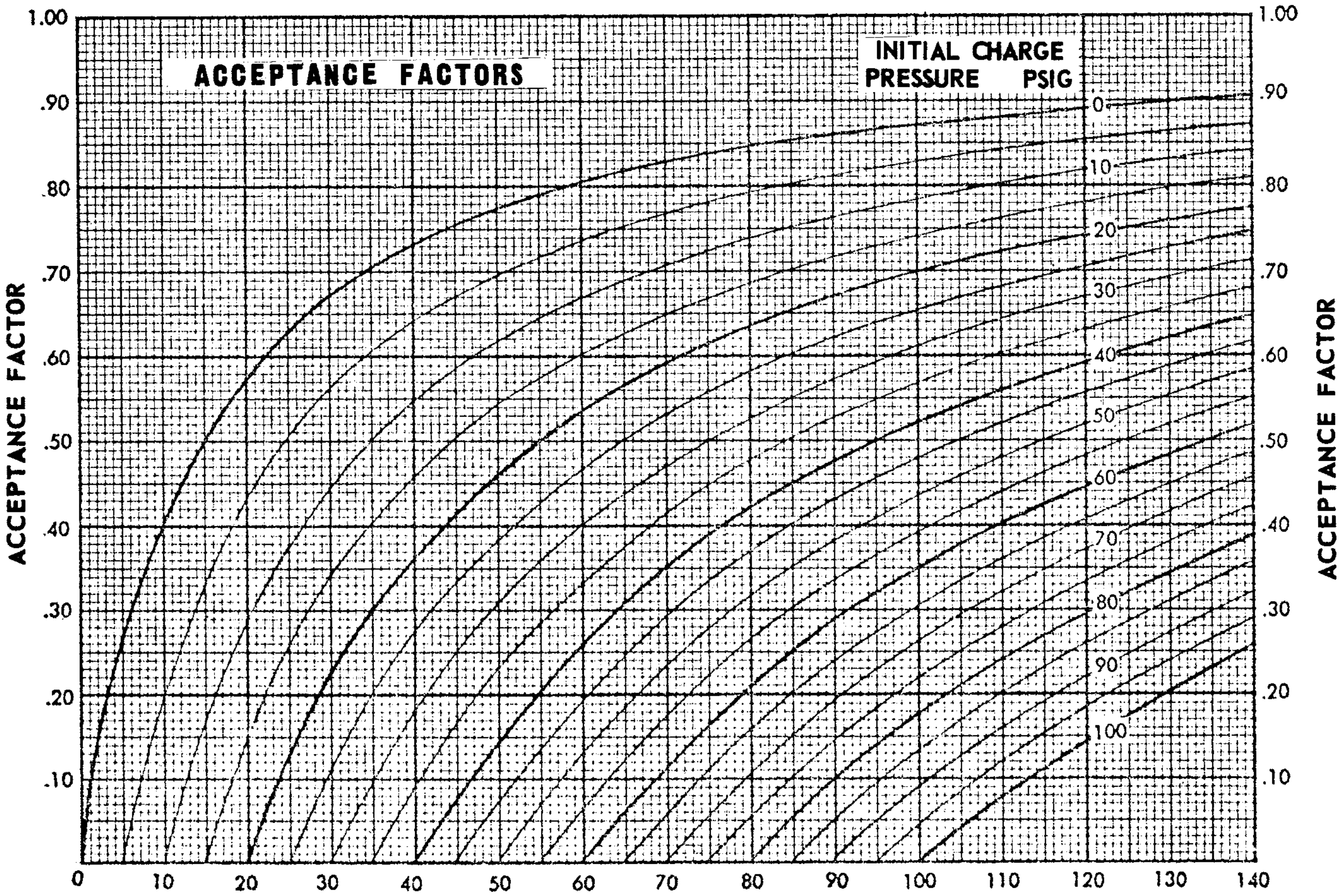
Net Expansion Factors for Water, Based on 40°F				
100° - .0060	130° - .0112	160° - .0190	190° - .0313	220° - .0436
110° - .0075	140° - .0133	170° - .0231	200° - .0354	230° - .0477
120° - .0093	150° - .0157	180° - .0272	210° - .0395	240° - .0518

NET EXPANSION FACTORS FOR WATER

To use this table: (1) For the system water temperature, read the expansion factor directly. (2) Multiply the expansion factor by the system volume to find the acceptance volume of the diaphragm type tank. (3) Proceed to Figure 3-12.

FIGURE 3-11

TABLE G



FINAL PRESSURE PSIG (NOT NECESSARILY RELIEF VALVE SETTING)

ACCEPTANCE FACTORS FOR DIAPHRAGM TYPE TANKS

To use this Figure: (1) Enter the horizontal scale at the final system pressure. (2) Move up vertically to the curved line for the initial charge pressure. (3) Read the acceptance factor on the vertical scale. (4) Divide acceptance volume from Figure 3-11 by the acceptance factor to obtain diaphragm type tank volume.

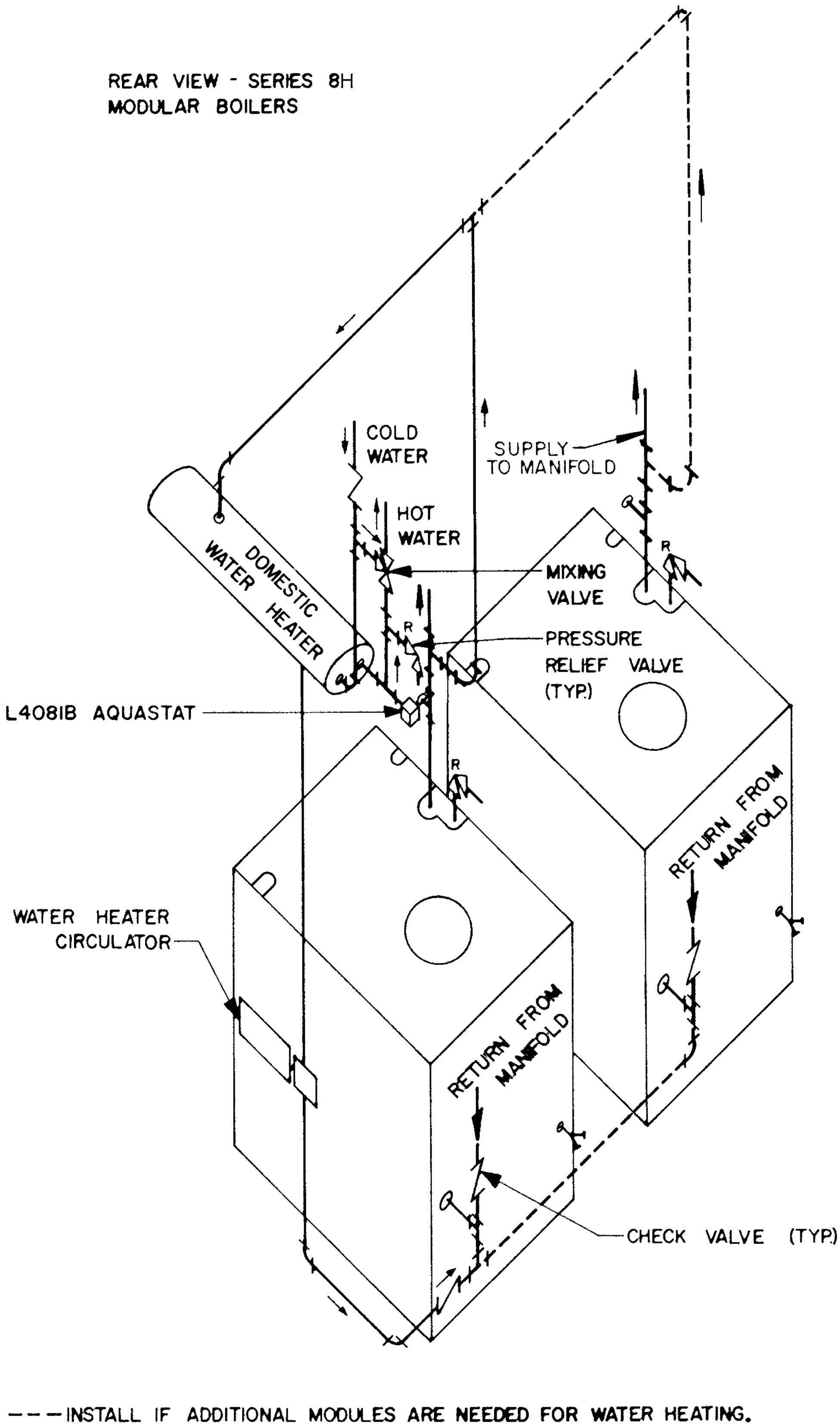
FIGURE 3-12

Module Size	Heating Surface, Ft^2	Water Volume, Gallon
805H	34.4	11.9
806H	42.6	13.9
807HE	50.8	15.9
808HE	59.0	17.9
809HE	67.2	19.9
810HE	75.4	21.9

MODULE DATE - WATER SIDE

FIGURE 3-13

RECOMMENDED WATER PIPING FOR DOMESTIC WATER HEATER



---INSTALL IF ADDITIONAL MODULES ARE NEEDED FOR WATER HEATING.
DO NOT BLOCK PASSAGEWAYS NOR ACCESS TO TOP AND FRONT JACKET PANELS.

FIGURE 3-14

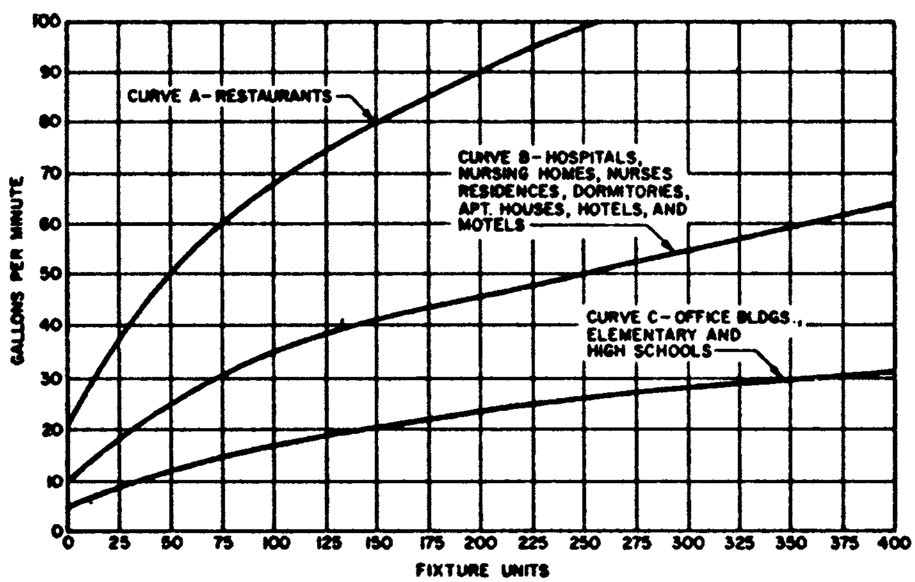
	Apartment House	Club	Gymnasium	Hospital	Hotels and Dormitories	Industrial Plant	Office Bldg.	School	YMCA
Basins, Private Lavatory	¾	¾	¾	¾	¾	¾	¾	¾	¾
Basins, Public Lavatory	---	1	1	1	1	1	1	1	1
Bathtubs	1½	1½	---	1½	1½	---	---	---	---
Dishwashers	1½	Five (5) *Fixture Units* per 250 seating capacity							
Therapeutic Bath	---	---	---	5	---	---	---	---	---
Kitchen Sink	¾	1½	---	3	1½	3	---	¾	3
Pantry Sink	---	2½	---	2½	2½	---	---	2½	2½
Slop Sink	1½	2½		2½	2½	2½	2½	2½	2½
Showers*	1½	1½	1½	1½	1½	3	---	1½	1½
Circular Wash Fountain	---	2½	2½	2½	---	4	---	2½	2½
Semi-circular Wash Fountain	---	1½	1½	1½	---	3	---	1½	1½

* In applications where principal use is showers, as in gymnasiums or at end of shift in industrial plants, use conversion factor of 1.00 to obtain design water flow rate in gpm.

SERVICE HOT WATER DEMAND, FIXTURE UNITS

TO USE THIS TABLE: (1) FOR THE TYPE OF FIXTURE AND TYPE OF BUILDING, READ DIRECTLY THE FIXTURE UNITS. (2) MULTIPLY THE FIXTURE UNITS BY THE TOTAL NUMBER OF FIXTURES OF ONE TYPE. (3) ADD TOGETHER THE FIXTURE UNITS FOR EACH TYPE TO OBTAIN THE TOTAL FIXTURE UNITS FOR THE BUILDING. (4) PROCEED TO FIGURE 3-16.

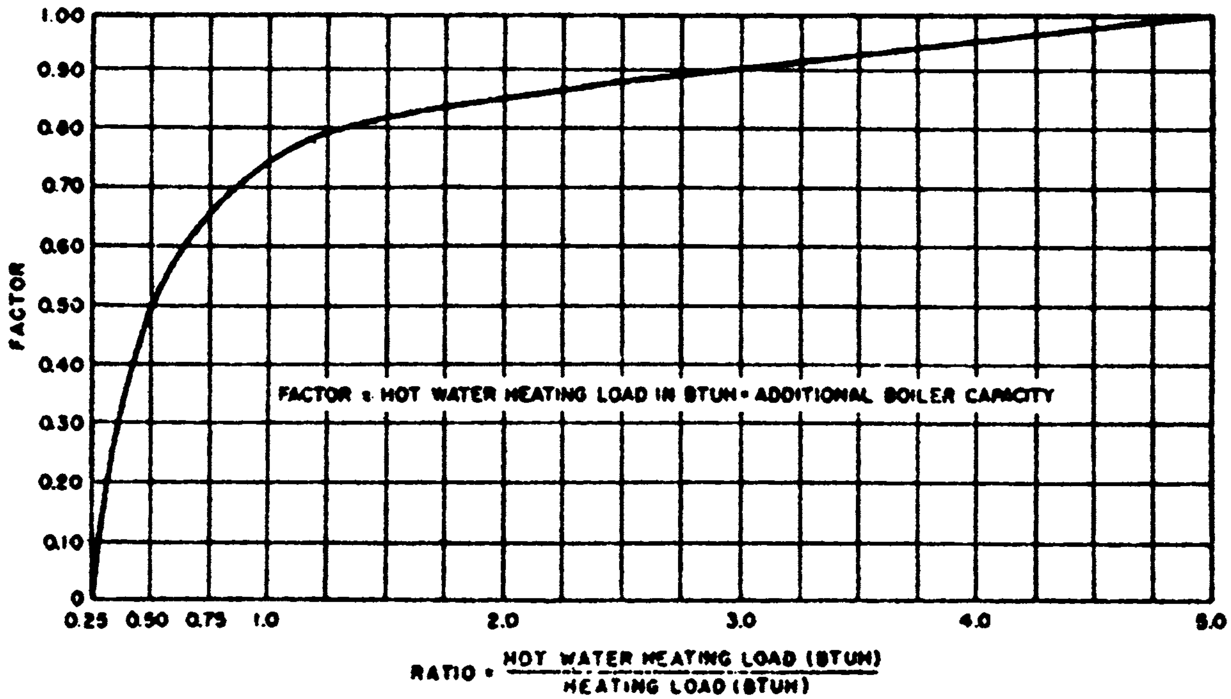
FIGURE 3-15



SERVICE HOT WATER FLOW RATE

TO USE THIS FIGURE: (1) ENTER THE HORIZONTAL SCALE AT THE TOTAL FIXTURE UNITS OBTAINED FROM FIGURE 3-15. (2) MOVE UP VERTICALLY TO THE CURVE MARKED FOR THE TYPE OF BUILDING. (3) READ THE REQUIRED SERVICE WATER FLOW RATE ON THE VERTICAL SCALE.

FIGURE 3-16



SIZING FACTORS FOR COMBINATION HEATING / SERVICE WATER BOILERS

TO USE THIS FIGURE: (1) CALCULATE RATIO OF HOT WATER HEATING LOAD TO HEATING LOAD. (2) ENTER HORIZONTAL SCALE AND MOVE UPWARD TO THE CURVE. (3) READ HOT WATER HEATING LOAD FACTOR ON THE VERTICAL SCALE. (4) MULTIPLY FACTOR BY THE HEATING LOAD TO OBTAIN THE HOT WATER "ADDED BOILER CAPACITY." (5) SELECT MODULES WITH TOTAL NET RATING EQUAL TO HEATING LOAD PLUS HOT WATER "ADDED BOILER CAPACITY."

FIGURE 3-17

SECTION 4.0 – GAS PIPING

⚠WARNING

Failure to properly pipe gas supply to boiler may result in improper operation and damage to the boiler or structure. Always assure gas piping is absolutely leak free and of the proper size and type for the connected load.
An additional gas pressure regulator may be needed. Consult gas supplier.

⚠WARNING

Failure to use proper thread compounds on all gas connectors may result in leaks of flammable gas.

⚠WARNING

Gas supply to boiler and system must be absolutely shut off prior to installing or servicing boiler gas piping.

4.1 General – Breeching ducts and water pipes are generally less flexible in design location than are gas pipes. To avoid conflicts for a given location, design and layout breeching ducts and water piping before proceeding with gas piping in this section.

4.2 Gas Piping Design and Layout – On a scaled drawing of the boiler room locate the boiler modules as planned in SECTION 2. Locate the gas meter on the drawing. Observe that the opening in the module jacket for gas piping is on the top surface at the right side front corner. The gas connection to the module gas train is inside the module vestibule and on the right side 12" above the floor.

4.2.1 Using Figures 4-1 and 4-2 decide on the simplest piping arrangement for the module layout. The location of the gas meter in relation to the modules has a large effect on the length and size of the gas piping. Long mains with many fittings should be avoided as the minimum pipe size required increases as the length of pipe and number of fittings increases. For this reason it is desirable to ask the gas supplier to set the gas meter as close to the boiler room as possible.

4.2.3 On the plans, draw the gas piping using the shortest possible route from meter to modules while observing the need to keep passageways open around all modules for servicing. It is highly recommended that the gas main be located horizontal, at the ceiling level of the boiler room, and directly over the front base line of the modules. The branch lines from the main should be vertical and direct to the modules.

4.2.4 On the plans, measure the total distance, including vertical runs, from the gas meter to the furthest module, and count the main fitting ells in that furthest run. (Straight flow through a tee is not counted as a fitting)

4.2.5 Obtain from the gas supplier the following information:
a) type of gas (natural or propane)
b)specific gravity
c)heating value

4.3 Gas Pipe Sizing (Preferred Method)

4.3.1 Figure 4-3 may be used for sizing pipes and fittings if all of the following conditions are met:
a) the distance from the gas meter to the furthest module is no more than fifty feet and has no more than three ells, and
b) the maximum supply gas pressure at the meter is 0.5 psig, and
c) the maximum supply gas pressure drop is 0.3 inches water column, and
d) the specific gravity of the gas is between 0.64 and 0.70 for natural or 1.50 and 1.63 for propane, and
e) the heating value of the gas is either 1000 Btu/Ft^3 for propane.

4.3.2 The procedure for sizing using Figure 4-3 is as follows:
1) Total the Input MBH (from figure 2-3) of all modules to be supplied by the gas pipe (and/or fitting) to be sized.
2) Locate this value in the left column.
3) Move to the right to the appropriate gas column, either Natural or Propane.
4) Read the pipe and/or fitting size. Record this on the gas pipe drawing.
5) The size of individual module supply piping -A, and the manual valve-B, should correspond to the Gas Connection size as tabulated in Figure 2-3. Record these sizes on the gas pipe drawing.

Example #1: Eight 809HE modules are to be piped in line, similar to Figure 4-1, on natural gas.
Size the piping:
1) A check of the conditions for this job shows the measured length of pipe from the gas meter to the furthest module is 45 ft with 3 ells. The gas supplier says that his system will deliver 4224 cubic feet at 0.5 psig at the meter, and his gas has 0.65 specific gravity and 1000 Btu/Ft^3 heating value. Figure 4-3 can be used.
2) The piping (D^8) between the gas meter and the first module take-off (C^8) serves eight modules. From Figure 23, each 809HE module requires 460 MBH Input. 8 x 460 = 3680. MBH- Total Input thru D^8.
3) Enter the left column in Figure 4-3 with 3680 total input MBH, which falls between the figure values of 3630-5610.
4) Read across to the "Natural Gas" column and pick off a pipe/fitting size of 4". Record this on the gas pipe drawing as D^8.

5) The next piping segment, D^7, serves seven modules. 7 x 460 = 3220 MBH – Total Input thru D^7.
6) Enter Figure 4-3 with 3220 Total Input MBH and again pick off a pipe/fitting size of 4”. Record this as D^7.
7) In like manner:

D^6 = 3”	D^3 = 2½”
D^5 = 3”	D^2 = 2”
D^4 = 3”	D^1, C^1 = 1½”

8) Since all modules require the same input MBH, D^1 – 1½” applies to the vertical drops to each module.
9) From Figure 2-3 the modules’ Gas Connection size is determined to be 1” MPT (non-IRI assumed for this example).
10) Record each module’s supply piping (A) and manual valve (B) sizes as 1”.
11) By inspection the reducing tee fittings © in the horizontal gas line can be sized based on the adjacent pipe sizes.

C^8 is between D^8 which is 4” and D^7 which is also 4” and feeds D^1 which is 1½”. Hence C^8 should be recorded on the drawing as 4” x 4” x 1½”.

12) In like manner:

C^7 = 4 x 3 x 1½	C^4 = 3 x 2½ x 1½
C^6 = 3 x 3 x 1½	C^3 = 2½ x 2 x 1½
C^5 = 3 x 3 x 1½	C^2 = 2 x 1½ x 1½

13) Record all pipe and fitting sizes on the gas pipe drawing for reference during installation.

4.4 Gas Pipe Sizing (Alternate Method)

4.4.1 If all of the conditions for using Figure 4-3 are not met, the following procedure must be used to size gas piping:

1) Determine the total equivalent length of pipe from the meter to the furthest module by adding to the measured length the equivalent length of each fitting from Figure 4-4. (Straight thru flow through a tee is not considered a fitting).
2) Determine the actual cubic feet of gas to be carried by the main segment by dividing the BTU requirement by the heating value of the gas.
3) Determine the equivalent cubic feet of .60 specific gravity gas by multiplying the actual cubic feet from 2) above by the appropriate specific gravity multiplier from Figure 4-6.
4) Enter Figure 4-5 under column for the total equivalent length of pipe as found in 1) above.
5) Read down until finding a number equal to or greater than the equivalent cubic feet from 3) above, which the main segment is required to carry.
6) Read across to the left hand column and pick off the minimum pipe size required.

Example #2: Eight 809HE modules are to be piped in line with propane from a tank source 115 feet from the furthest module and 8 ells are in the supply line. The propane to be used has a specific gravity of 1.40 and a heating value of 2420 Btu/Ft³. Size the piping:

a) To the measured length of 115’ add the equivalent length of 8 ells x 10.1 Ft/Ell for a total equivalent of 195.8 Ft. (The factor of 10.1 comes from Figure 4-4 under the column for ells at an estimated 4” main size.)
b) The actual cubic feet required in main D^8 is

$$\frac{\text{8 (modules) x 460,000 (Btu/809HE)}}{\text{2420 (BTU/Ft}^3\text{)}} = 1521 \text{ Ft}^3\text{/Hr}$$

In a like manner the actual cubic feet required in the remaining main segments are found to be:

Flow D^7 = 7 x 460,000 ÷ 2420 = 1331 Ft³/Hr
Flow D^6 = 6 x 460,000 ÷ 2420 = 1141 Ft³/Hr
Flow D^5 = 5 x 460,000 ÷ 2420 = 950 Ft³/Hr
Flow D^4 = 4 x 460,000 ÷ 2420 = 760 Ft³/Hr
Flow D^3 = 3 x 460,000 ÷ 2420 = 570 Ft³/Hr
Flow D^2 = 2 x 460,000 ÷ 2420 = 380 Ft³/Hr
Flow D^1 = 1 x 460,000 ÷ 2420 = 190 Ft³/Hr

c) Enter figure 4-6 at a specific gravity of 1.40 and note the multiplier of 1.3. Tabulate equivalent flow rates for each pipe segment as follows:

Equiv. Flow D8 = 1521 x 1.53 = 2327 Ft³/Hr
Equiv. Flow D7 = 1331 x 1.53 = 2036 Ft³/Hr
Equiv. Flow D6 = 1141 x 1.53 = 1746 Ft³/Hr
Equiv. Flow D5 = 950 x 1.53 = 1454 Ft³/Hr
Equiv. Flow D4 = 760 x 1.53 = 1163 Ft³/Hr
Equiv. Flow D3 = 570 x 1.53 = 872 Ft³/Hr
Equiv. Flow D2 = 380 x 1.53 = 581 Ft³/Hr
Equiv. Flow D1 = 190 x 1.53 = 291 Ft³/Hr

d) Enter Figure 4-5 from the top at column marked 200 Ft. of pipe. The length found in a) above was 195.8 Ft. which is between column marked 175 and 200 Ft. Use next larger of 200 Ft.
e) Read down until finding a number equal to or greater than the equivalent cubic foot flow requirement found in c) above.
f) Read across to the left hand column and pick off the following required minimum pipe sizes:

Size D^8 = 4”
Size D^7 = 4”
Size D^6 = 4”
Size D^5 = 3”
Size D^4 = 3”
Size D^3 = 2½”
Size D^2 = 2”
Size D^1 = 1½”

g) D1 = 1½” becomes the vertical riser from each of the modules to the overhead horizontal main.
h) Mark all pipe sizes on the plan for reference during installation.

4.5 Gas Pipe Installation

With modules fully assembled, including jackets, install gas supply piping in accordance with the current edition of “National Fuel Gas Code” (ANSI

Z223.1) and all requirements of the gas supplier and municipality.

4.5.1 Please consider the serviceman who must periodically clean and adjust the modules, and repair accessories. Do not block passageways with piping. Do not block access panels on the module jackets.

4.5.2 Material – Use only Schedule 40 black iron pipe. Make sure all threads are fully formed and free of burrs. Threaded joints should be sealed with an approved compound to prevent leaks.

4.5.3 Traps – Install a trap similar to that shown in Figure 4-8 at the low end of the vertical run to each module.

4.5.4 Supports – Pipe supports should be installed according to Figure 4-7. Supports should encircle the pipe at ceiling level but allow movement for expansion of the piping. The weight of the gas piping must not be placed upon the module gas connection.

4.5.5 Grounding – Gas piping must be grounded. If any non-conductive fittings are used they must be bridged with an appropriately sized ground wire. Particular attention should be given to a propane system with above ground tank(s). Such tank(s) must be externally grounded.

4.5.6 Leak Testing – If the gas lines have been designed according to preceding sections of this manual, the operating gas pressure will be 0.5 psig. Under such pressure, fuel gas may be used for leak testing. On each module, turn the manual portion of combination valve to off position before applying gas pressure. Immediately after applying gas pressure, apply leak check solution to all gas piping and observe piping for leaks. Repair any leaks found and retest piping. If the gas supplier requires leak testing at pressures higher than 0.5 psig, or with inert gas, follow that required procedure in full.

4.6 Gas Piping Maintenance – Piping should be inspected annually or after any extended shut down period. If the normal operating gas pressure is 0.5 psig or less, fuel gas can be used for leak detection as described in 4.5.6 above.

4.6.1 Any pipe or fitting showing unusual rust or corrosion should be replaced.

4.6.2 Gas piping should not be used as an electrical conductor. Relocate any electrical circuit which is found to be using the gas piping as a conductor.

Note: Many municipalities allow light weight, low voltage, well insulated electrical wire to be supported on the gas piping with approved non-conductive fasteners.

4.6.3 Gas piping should not be used to support any other pipe or heavy object. Find other means to support any such heavy object.

4.6.4 Traps should be cleaned at least once every two years. Turn off gas supply, remove cap below tee, as shown in Figure 4-8, and clean out all moisture and foreign material. Replace cap and check for leaks as described in 4.5.6 above.

RECOMMENDED GAS SUPPLY PIPING - 1 THRU 8 MODULES IN LINE OR CORNERED.

(ALL PIPING SHOWN SUPPLIED BY INSTALLER)

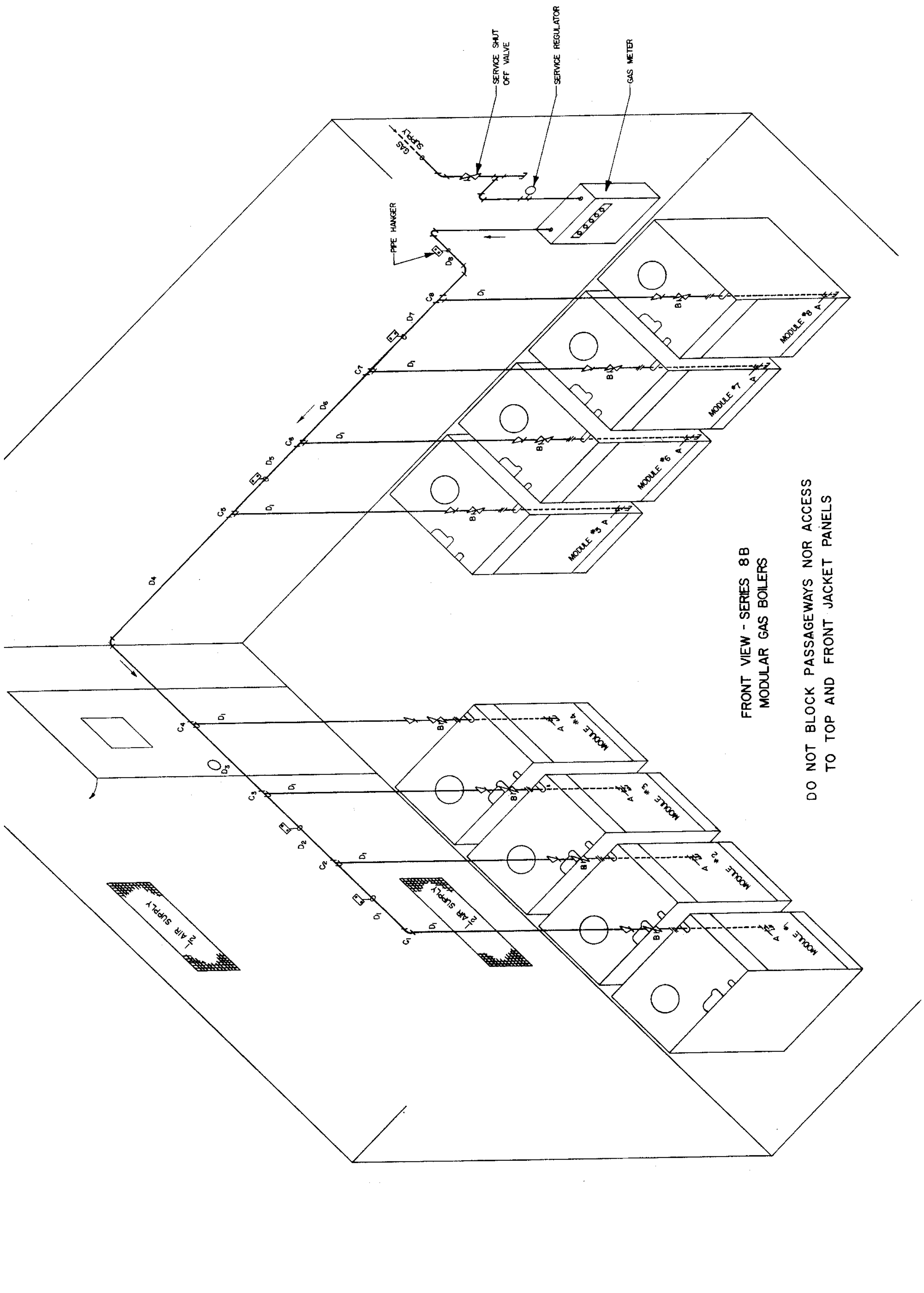


FIGURE 4-1

RECOMMENDED GAS SUPPLY PIPING - TWO ROWS OF 1 THRU 4 MODULES
EACH BACK-TO-BACK OR CORNERED, OR 1 THRU 8 MODULES IN LINE.

(ALL PIPING SHOWN SUPPLIED BY INSTALLER)

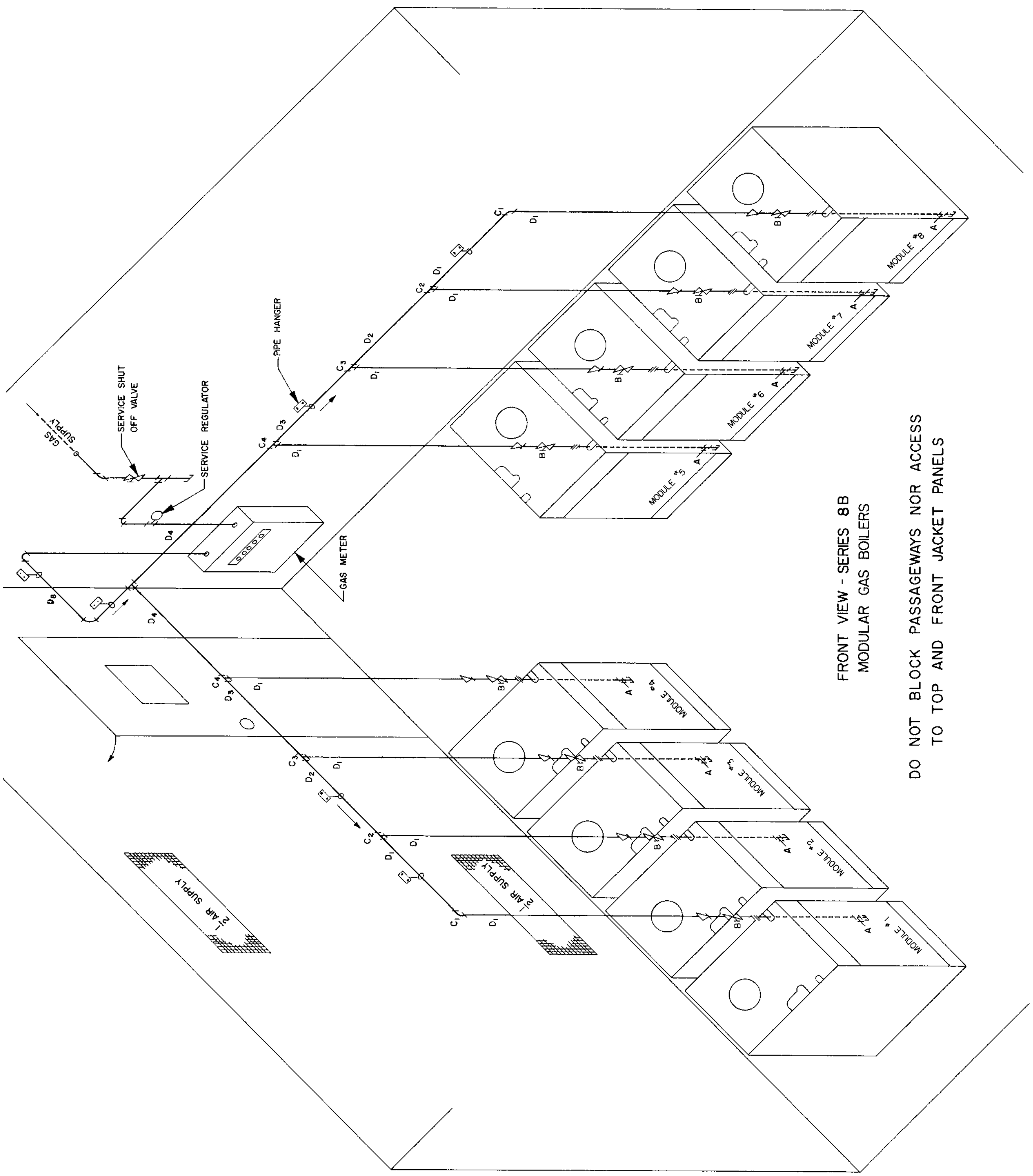


FIGURE 4-2

NOTICE

Use this table only if all of the following conditions are met:

1) 50 Ft. maximum plus 3 ells from Meter to furthest Module Gas Connection
2) 0.5 PSIG Maximum Gas Pressure
3) 0.3 Inch Water Column Pressure Drop
4) Specific Gravity of Natural Gas = 0.64 to 0.70
   Propane = 1.50 to 1.63
5) Heating value of
   Natural Gas = 1000 Btu/Ft³
   Propane Gas = 2500 Btu/Ft³

Otherwise, refer to the Alternate Method of Gas Pipe Sizing in 4.4.

Total Input MBH of Module(s) Served by Pipe/Fitting	Pipe/Fitting Size (NPT)	
	Natural Gas	Propane Gas
264. - 330.	1¼"	1"
396.	1¼"	1¼"
462. - 660.	1½"	1¼"
726. - 990.	2"	1½"
1056. - 1254.	2"	2"
1320. - 1980.	2½"	2"
2046. - 3102.	3"	2½"
3168. - 3564.	3"	3"
3630. - 5610.	4"	3"

To use this table: (1) Total the Input MBH (from Figure 2-3) of all modules to be supplied by the gas pipe (and/or fitting) to be sized (2) Locate this Total MBH in the left column (3) Move to the right to the appropriate gas column (4) Read the pipe and/or fitting size.

FIGURE 4-3

Nominal Pipe Size, In.	Inside Dia., Schedule 40, In.	Screwed Fittings				Valves (screwed, flanged, or welded)			
		45° Ell	90° Ell	180° Close Return Bends	Tee	Gate	Globe	Angle	Swing Check
½	0.622	0.73	1.55	3.47	3.10	0.36	17.3	8.65	4.32
¾	0.824	0.96	2.06	4.60	4.12	0.48	22.9	11.4	5.72
1	1.019	1.22	2.62	5.82	5.24	0.61	29.1	14.6	7.27
1¼	1.380	1.61	3.45	7.66	6.90	0.81	38.3	19.1	9.58
1½	1.610	1.88	4.02	8.95	8.04	0.94	44.7	22.4	11.2
2	2.067	2.41	5.17	11.5	10.3	1.21	57.4	28.7	14.4
2½	2.469	2.88	6.16	13.7	12.3	1.44	68.5	34.3	17.1
3	3.068	3.58	7.67	17.1	15.3	1.79	85.2	42.6	21.3
4	4.026	4.70	10.1	22.4	20.2	2.35	112	56.0	28.0
5	5.047	5.88	12.6	28.0	25.2	2.94	140	70.0	35.0

EQUIVALENT LENGTH OF FITTINGS AND VALVES - GAS PIPE (FT)

TO USE THIS TABLE: (1) ENTER LEFT HAND COLUMN AT REQUIRED PIPE SIZE. (2) MOVE TO THE RIGHT TO THE RIGHT TO THE COLUMN FOR THE TYPE OF FITTING. (3) READ THE EQUIVALENT LENGTH OF STRAIGHT PIPE FOR THAT ONE FITTING. (4) TOTAL THE EQUIVALENT LENGTH FOR EVERY FITTING IN THE SUPPLY LINE. (5) ADD THE TOTAL EQUIVALENT LENGTH FOR FITTINGS TO THE MEASURED LENGTH OF STRAIGHT PIPE TO OBTAIN THE EQUIVALENT LENGTH OF THE SUPPLY LINE.

FIGURE 4-4

Nominal Iron Pipe Size, In.	Internal Dia., In.	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/4	.364	32	22	18	15	14	12	11	11	10	9	8	8	7	6
3/8	.493	72	49	40	34	30	27	25	23	22	21	18	17	15	14
1/2	.622	132	92	73	63	56	50	46	43	40	38	34	31	28	26
3/4	.824	278	190	152	130	115	105	96	90	84	79	72	64	59	55
1	1.049	50	350	285	245	215	195	180	170	160	150	130	120	110	100
1-1/4	1.380	1,050	730	590	500	440	400	370	350	320	305	275	250	225	210
1-1/2	1.610	1,600	1,100	890	760	670	610	560	530	490	460	410	380	350	320
2	2.067	3,050	2,100	1,650	1,450	1,270	1,150	1,050	990	930	870	780	710	650	610
2-1/2	2.469	4,800	3,300	2,700	2,300	2,000	1,850	1,700	1,600	1,500	1,400	1,250	1,130	1,050	980
3	3.068	8,500	5,900	4,700	4,100	3,600	3,250	3,000	2,800	2,600	2,500	2,200	2,000	1,850	1,700
4	4.026	17,500	12,000	9,700	8,300	7,400	6,800	6,200	5,800	5,400	5,100	4,500	4,100	3,800	3,500

MAXIMUM CAPACITY OF PIPE (FT^3/HR)

(Based on gas pressure at 0.5 psig., pressure drop of 0.3" water column, and 0.60 specific gravity.)

TO USE THIS TABLE: (1) ENTER THE TOP ROW AT THE TOTAL EQUIVALENT LENGTH OF PIPE OBTAINED FROM 4.4.1 - 1). (2) MOVE DOWN TO THE EQUIVALENT GAS FLOW OBTAINED FROM 4.4.1 - 3). (3) MOVE ACROSS TO THE LEFT HAND COLUMN. (4) READ THE REQUIRED PIPE SIZE.

FIGURE 4-5

Specific Gravity	Multiplier	Specific Gravity	Multiplier
.35	.763	1.00	1.29
.40	.813	1.10	1.35
.45	.862	1.20	1.40
.50	.909	1.30	1.47
.55	.962	1.40	1.53
.60	1.00	1.50	1.58
.65	1.04	1.60	1.63
.70	1.08	1.70	1.68
.75	1.12	1.80	1.73
.80	1.15	1.90	1.77
.85	1.19	2.00	1.83
.90	1.22	2.10	1.87

CORRECTION FACTORS FOR SPECIFIC GRAVITY OTHER THAN .60

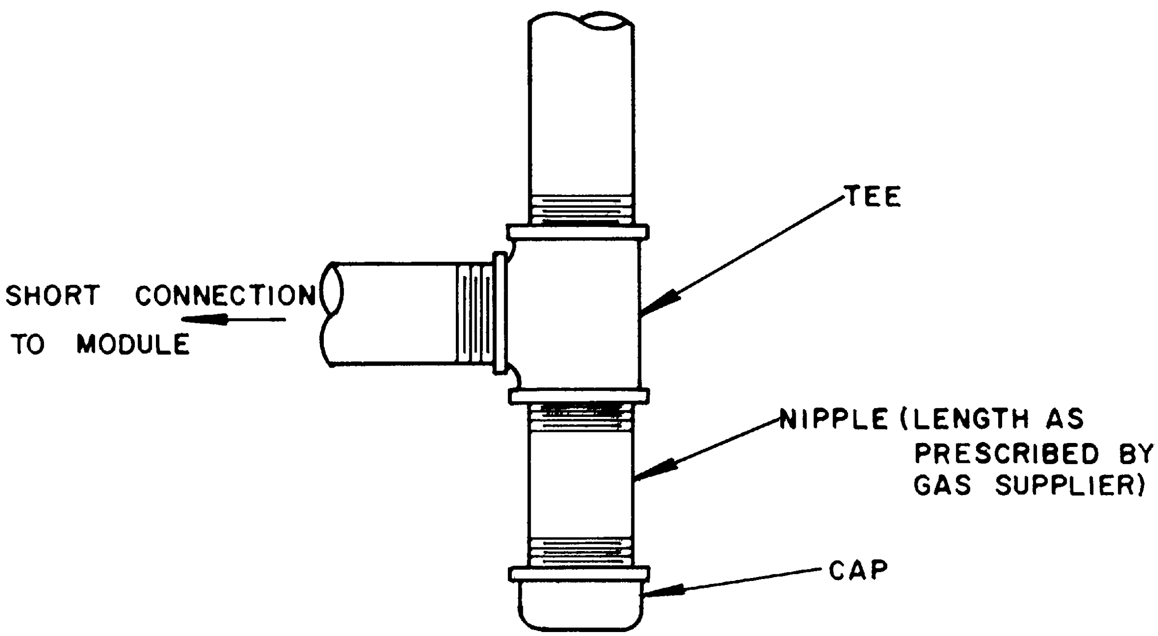
To use this table: (1) Read directly the multiplier for the specific gravity of the gas to be used. (2) Multiply actual gas flow rates by this multiplier to obtain equivalent flow rates for .60 specific gravity gas. (3) Enter Figure 4.5 with these equivalent gas flow rates to determine gas pipe sizes.

FIGURE 4-6

Size of Pipe (Inches)	Spacing of Supports (Feet)
½	6
¾ or 1	8
1¼ or larger (horizontal)	10
1¼ or larger (vertical)	Every floor level

SUPPORT OF PIPING

FIGURE 4-7



ALL PIPE AND FITTINGS TO BE SIZED ACCORDING TO MODULE SUPPLY PIPE SIZE

MOISTURE AND DIRT TRAP
FOR GAS SUPPLY TO EACH MODULE
SERIES 8H/8HE MODULAR GAS BOILER

FIGURE 4-8

SECTION 5.0 – CONTROLS

⚠DANGER

Positively assure all electrical connections are unpowered before attempting installation or service of electrical components or connections of the boiler or building. Lock out all electrical boxes with padlock once power is turned off.

⚠WARNING

Failure to properly wire electrical connections to the boiler may result in serious physical harm.
Electrical power may be from more than one source. Make sure all power is off before attempting any electrical work.
Each boiler must be protected with a properly sized fused disconnect.
Never jump out or make inoperative any safety or operating controls.
The wiring diagrams contained in this manual are for reference purposes only. Each boiler is shipped with a wiring diagram attached to the front door. Refer to this diagram and the wiring diagram of any controls used with the boiler. Read, understand and follow all wiring instructions supplied with the controls.

5.1 General – Breeching ducts, water piping and gas piping are generally less flexible than are electrical conductors. To avoid conflicts for the same location, design and layout breeching ducts, water and gas piping before proceeding with electrical and control layout in this section.

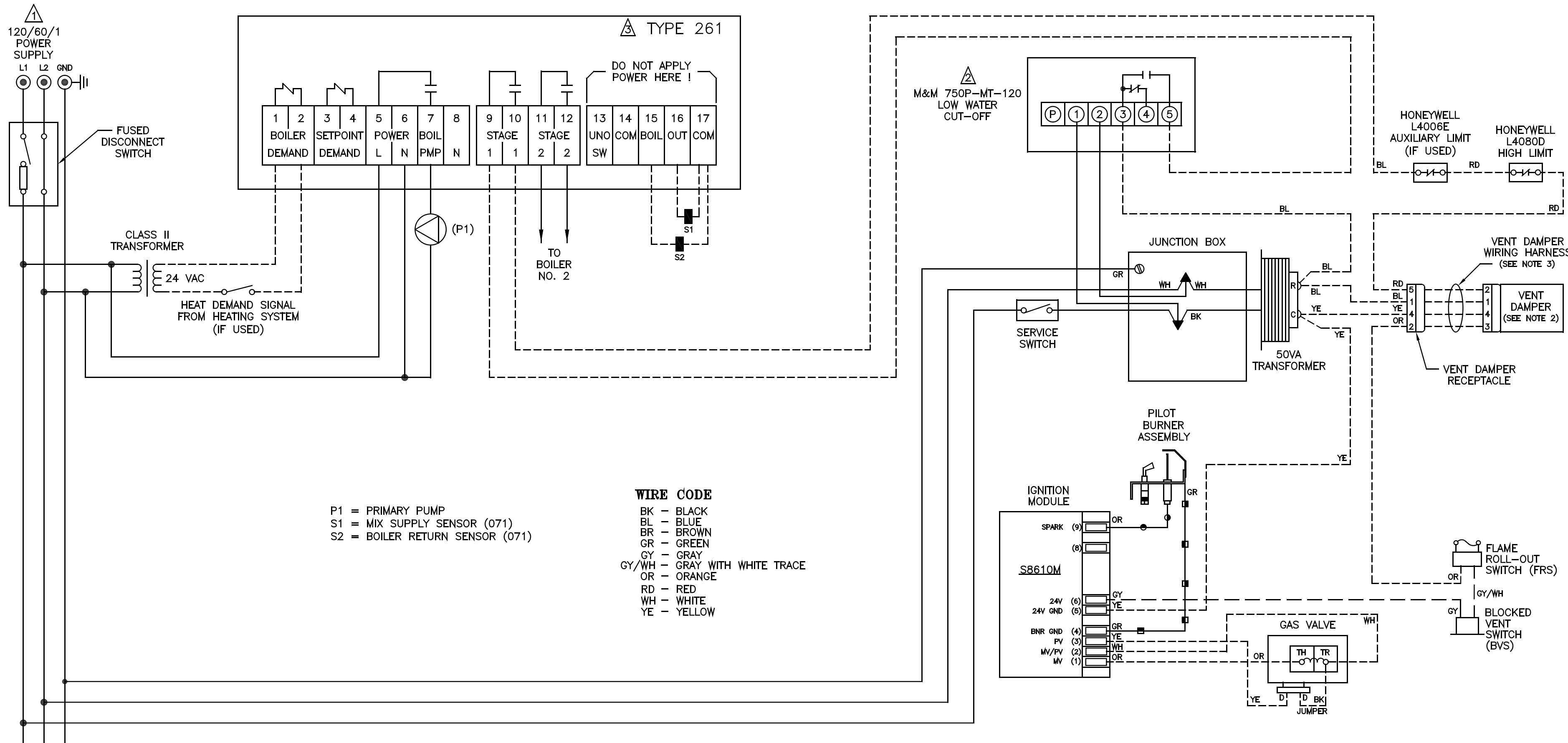
5.1.1 Selection of the control package should be based on:

1) The application or end use of the heat supplied by the modules (ie: is the application for space heating only, or will it be used for space and domestic hot water requirements).
2) The number of boilers being controlled.

5.1.2 Burnham Commercial offers Tekmar boiler staging controls that can stage and rotate up to eight modules. All Tekmar controls use PID logic for precise control over the desired supply water or domestic hot water temperature or both. Use the table below for selecting the proper control for the number of boilers being used.

Boiler Staging Control Features				
Feature:	**Tekmar Control Model Number:**			
	261	**263**	**274**	**268**
Boiler Operation				
Number of Stages	**2**	**2**	**4**	**9**
Boiler Differential	**A/M**	**A/M**	**A/M**	**A/M**
Boiler Minimum Supply	**M**	**M**	**M**	**M**
Boiler Outdoor Reset	o	o	o	o
Boiler Post Purge	**F**	**M**	**M**	**M**
Characterized Heating Curve	o	o	o	o
Equal Run Time Rotation	o	o	o	o
PID Staging	o	o	o	o
Fire Delay	**M**	**M**	**M**	**M**
Interstage Delay	**A**	**A**	**A/M**	**A/M**
External EMS Input Signal (0-10Vdc)			o	o
Warm Weather Shut Down	o	o	o	o
Domestic Hot Water (DHW) Operation				
DHW Priority With Reset Override		o	o	o
DHW External Demand (Aquastat)		o	o	o
DHW Internal Demand (Sensor)		o	o	
DHW Post Purge		o	o	o
DHW Setback		o	o	o
Setpoint Operation				
Setpoint Production		o	o	o
Setpoint Priority With Reset Override		o	o	o
Other Features and Functions				
Digital Display		o	o	o
Pump Exercising		o	o	o
Night Setback through Internal Timer		o	o	o
Night Setback through External Timer		o	o	o

A= Automatic Adjustment F=Fixed M=Manual Note: This is a partial list of features



NOTES:

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLID WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805, OPTIONAL ON MODELS 806 – 810.
3. FOR BOILER LESS VENT DAMPER ONLY; VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.
4. CANADA ONLY – ATTACH GREEN GROUND WIRE FROM TRANSFORMER TERMINAL "C" TO JACKET SCREW IN VESTIBULE.

⚠1 POWER SUPPLY – PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 M&M NO. 750P–MT LOW WATER CUT–OFF IS STANDARD ON 808, 809 AND 810.

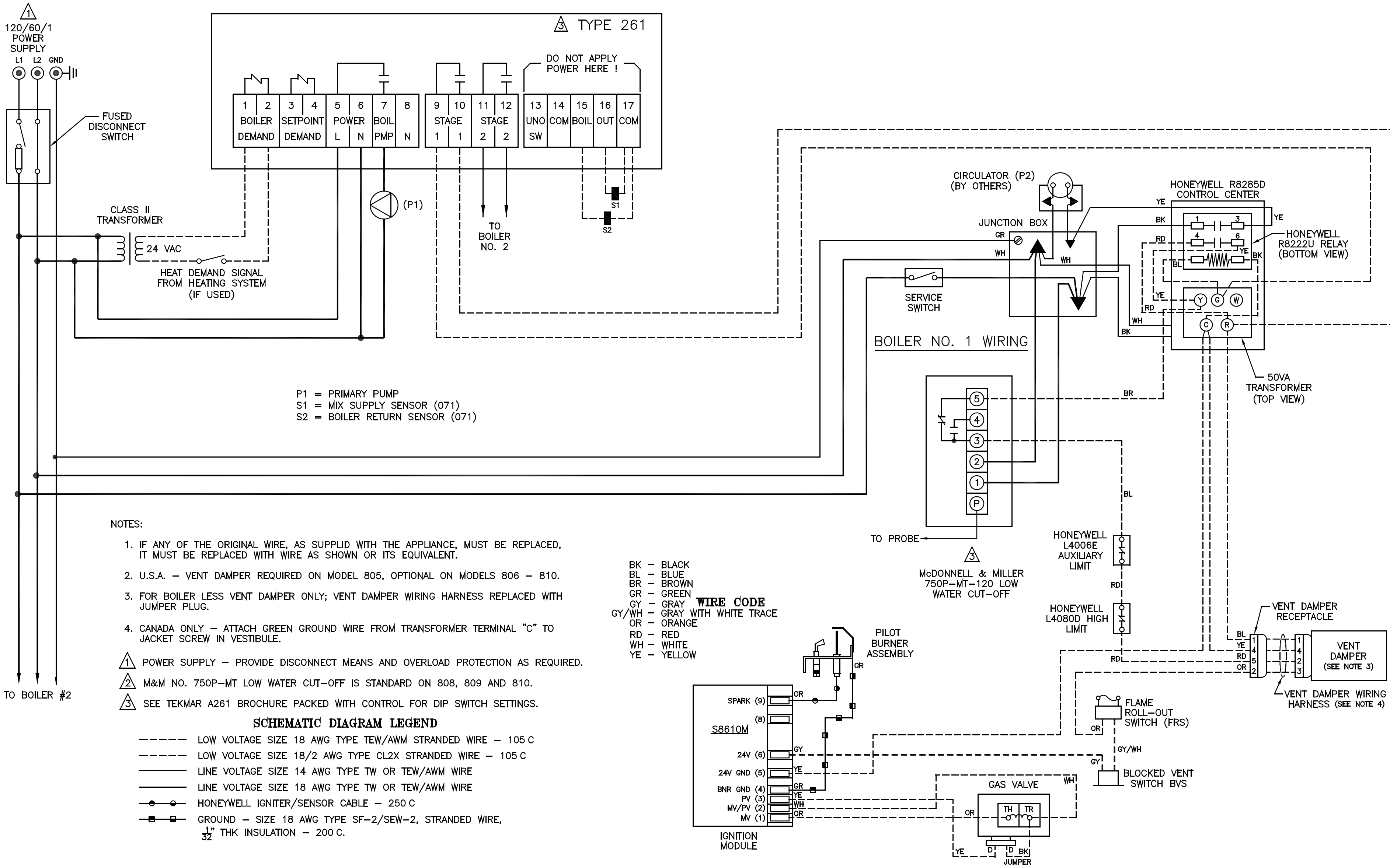
⚠3 SEE TEKMAR A261 BROCHURE PACKED WITH CONTROL FOR DIP SWITCH SETTINGS.

SCHEMATIC DIAGRAM LEGEND

- – – – – LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C
- – – – – LOW VOLTAGE SIZE 18/2 AWG TYPE CL2X STRANDED WIRE – 105 C
- ——— LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- ——— LINE VOLTAGE SIZE 18 AWG TYPE TW OR TEW/AWM WIRE
- —●—●— HONEYWELL IGNITER/SENSOR CABLE – 250 C
- —■—■— GROUND – SIZE 18 AWG TYPE SF–2/SEW–2, STRANDED WIRE, $\frac{1}{32}$" THK INSULATION – 200 C.

TEKMAR 261, TWO-STAGE, EI, FOR PARALLEL PIPING

FIGURE 5-1



NOTES:

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLID WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805, OPTIONAL ON MODELS 806 – 810.
3. FOR BOILER LESS VENT DAMPER ONLY; VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.
4. CANADA ONLY – ATTACH GREEN GROUND WIRE FROM TRANSFORMER TERMINAL "C" TO JACKET SCREW IN VESTIBULE.

1 POWER SUPPLY – PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2 M&M NO. 750P–MT LOW WATER CUT–OFF IS STANDARD ON 808, 809 AND 810.
3 SEE TEKMAR A261 BROCHURE PACKED WITH CONTROL FOR DIP SWITCH SETTINGS.

WIRE CODE

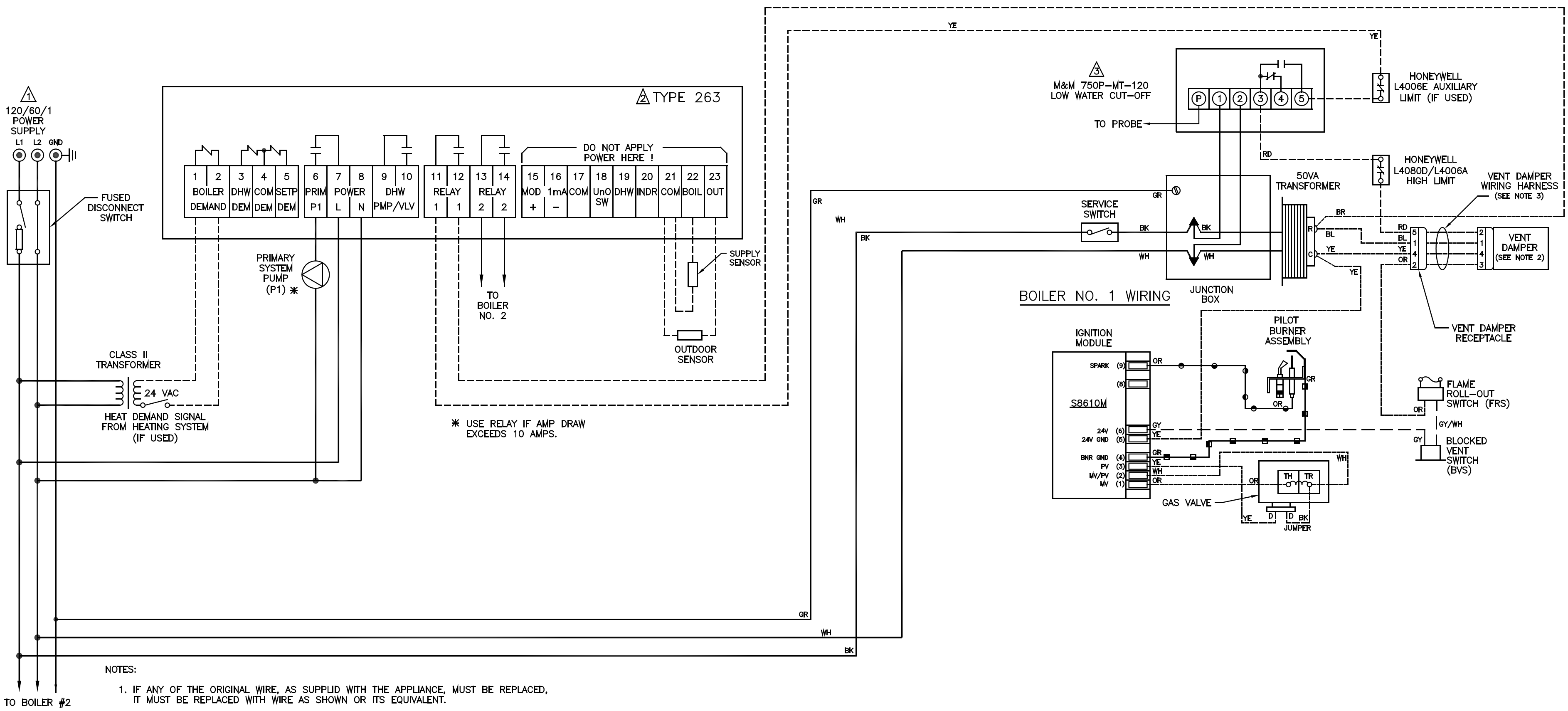
BK – BLACK
BL – BLUE
BR – BROWN
GR – GREEN
GY – GRAY
GY/WH – GRAY WITH WHITE TRACE
OR – ORANGE
RD – RED
WH – WHITE
YE – YELLOW

SCHEMATIC DIAGRAM LEGEND

- LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C
- LOW VOLTAGE SIZE 18/2 AWG TYPE CL2X STRANDED WIRE – 105 C
- LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE SIZE 18 AWG TYPE TW OR TEW/AWM WIRE
- HONEYWELL IGNITER/SENSOR CABLE – 250 C
- GROUND – SIZE 18 AWG TYPE SF–2/SEW–2, STRANDED WIRE, $\frac{1}{32}$" THK INSULATION – 200 C.

TEKMAR 261, TWO-STAGE, EI, FOR PRIMARY SECONDARY PIPING

FIGURE 5-2



NOTES:

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLID WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805, OPTIONAL ON MODELS 806 – 810.
3. FOR BOILER LESS VENT DAMPER ONLY: VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.
4. CANADA ONLY – ATTACH GREEN GROUND WIRE FROM TRANSFORMER TERMINAL "C" TO JACKET SCREW IN VESTIBULE.

⚠1 POWER SUPPLY – PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 SEE TEKMAR A263 BROCHURE PACKED WITH CONTROL FOR DIP SWITCH SETTINGS.

⚠3 M&M NO. 750P–MT LOW WATER CUT–OFF IS STANDARD ON 808, 809 and 810.

SCHEMATIC DIAGRAM LEGEND

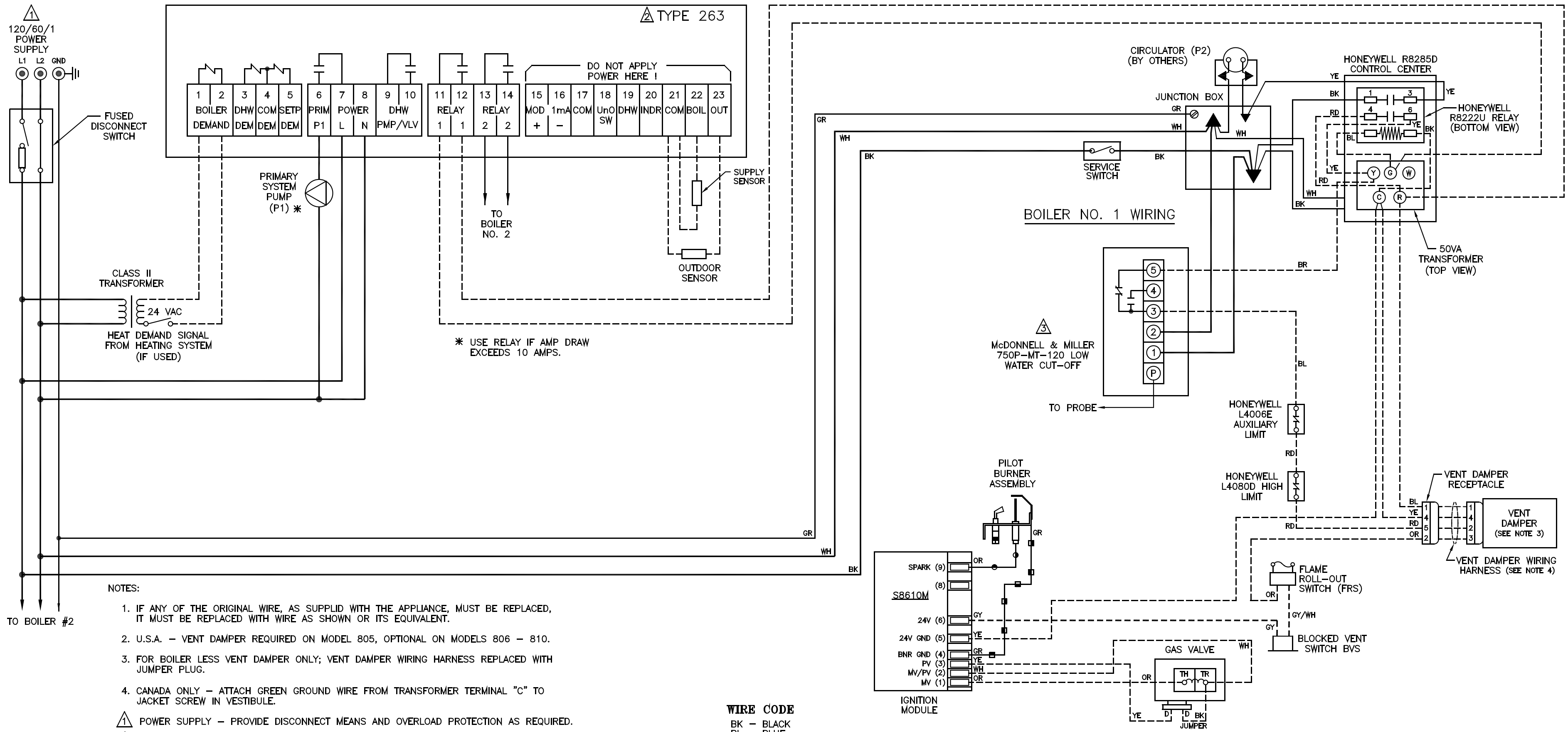
- LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C
- LOW VOLTAGE SIZE 18/2 AWG TYPE CL2X STRANDED WIRE – 105 C
- LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE SIZE 18 AWG TYPE TW OR TEW/AWM WIRE
- HONEYWELL IGNITER/SENSOR CABLE – 250 C
- GROUND – SIZE 18 AWG TYPE SF–2/SEW–2, STRANDED WIRE, $\frac{1}{32}$" THK INSULATION – 200 C

WIRE CODE

BK – BLACK
BL – BLUE
BR – BROWN
GR – GREEN
GY – GRAY
GY/WH – GRAY WITH WHITE TRACE
OR – ORANGE
RD – RED
WH – WHITE
YE – YELLOW

TEKMAR 263, TWO-STAGE, EI, FOR PARALLEL PIPING

FIGURE 5-3



NOTES:

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLID WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805, OPTIONAL ON MODELS 806 – 810.
3. FOR BOILER LESS VENT DAMPER ONLY; VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.
4. CANADA ONLY – ATTACH GREEN GROUND WIRE FROM TRANSFORMER TERMINAL "C" TO JACKET SCREW IN VESTIBULE.

⚠1 POWER SUPPLY – PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 SEE TEKMAR A263 BROCHURE PACKED WITH CONTROL FOR DIP SWITCH SETTINGS.

⚠3 M&M NO. 750P-MT LOW WATER CUT-OFF IS STANDARD ON 808, 809 and 810.

SCHEMATIC DIAGRAM LEGEND

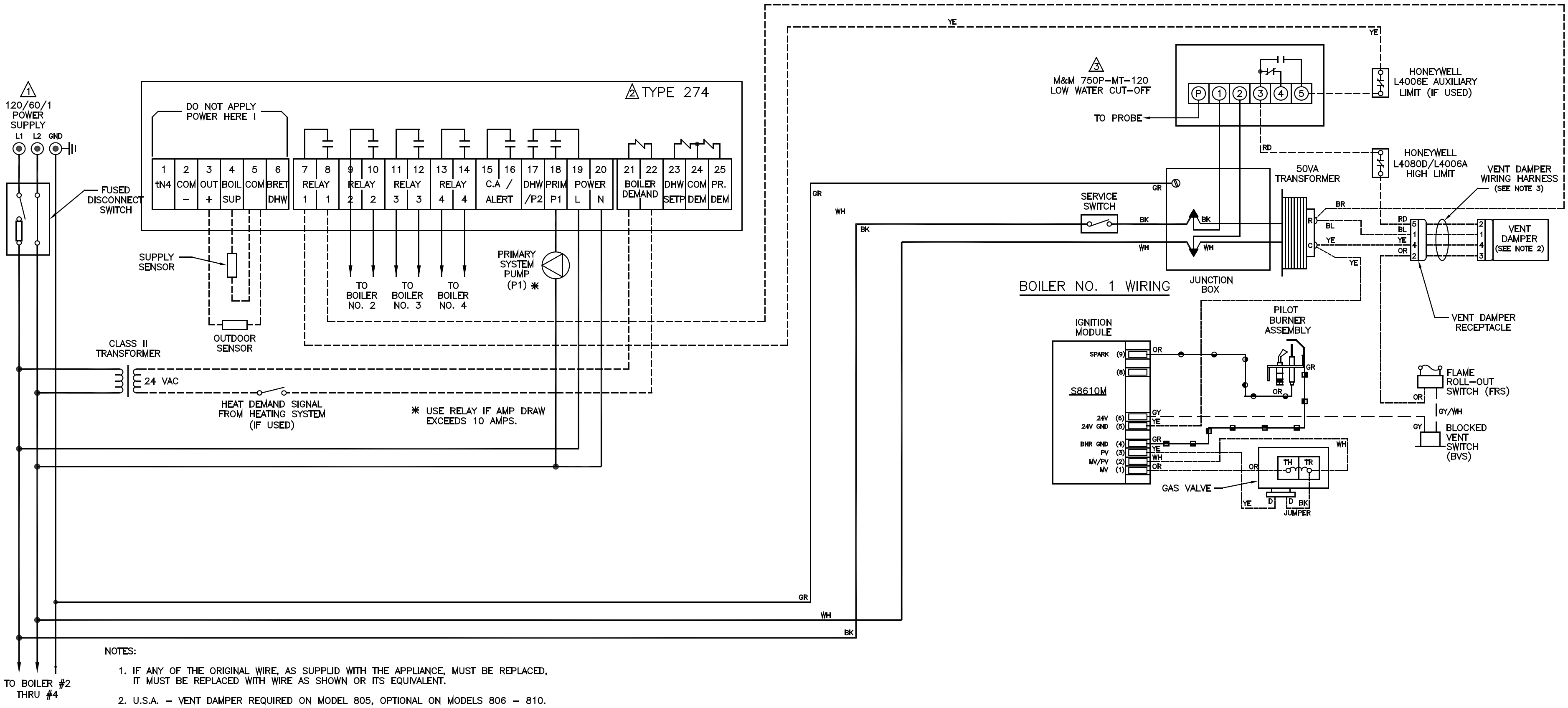
- LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C
- LOW VOLTAGE SIZE 18/2 AWG TYPE CL2X STRANDED WIRE – 105 C
- LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE SIZE 18 AWG TYPE TW OR TEW/AWM WIRE
- HONEYWELL IGNITER/SENSOR CABLE – 250 C
- GROUND – SIZE 18 AWG TYPE SF-2/SEW-2, STRANDED WIRE, $\frac{1}{32}$" THK INSULATION – 200 C

WIRE CODE

BK – BLACK
BL – BLUE
BR – BROWN
GR – GREEN
GY – GRAY
GY/WH – GRAY WITH WHITE TRACE
OR – ORANGE
RD – RED
WH – WHITE
YE – YELLOW

TEKMAR 263, TWO-STAGE, EI, FOR PRIMARY SECONDARY PIPING

FIGURE 5-4



NOTES:

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLID WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805, OPTIONAL ON MODELS 806 – 810.
3. FOR BOILER LESS VENT DAMPER ONLY; VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.
4. CANADA ONLY – ATTACH GREEN GROUND WIRE FROM TRANSFORMER TERMINAL "C" TO JACKET SCREW IN VESTIBULE.

⚠1 POWER SUPPLY – PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 SEE TEKMAR A274 BROCHURE PACKED WITH CONTROL FOR DIP SWITCH SETTINGS.

⚠3 M&M NO. 750P-MT LOW WATER CUT-OFF IS STANDARD ON 808, 809 and 810.

SCHEMATIC DIAGRAM LEGEND

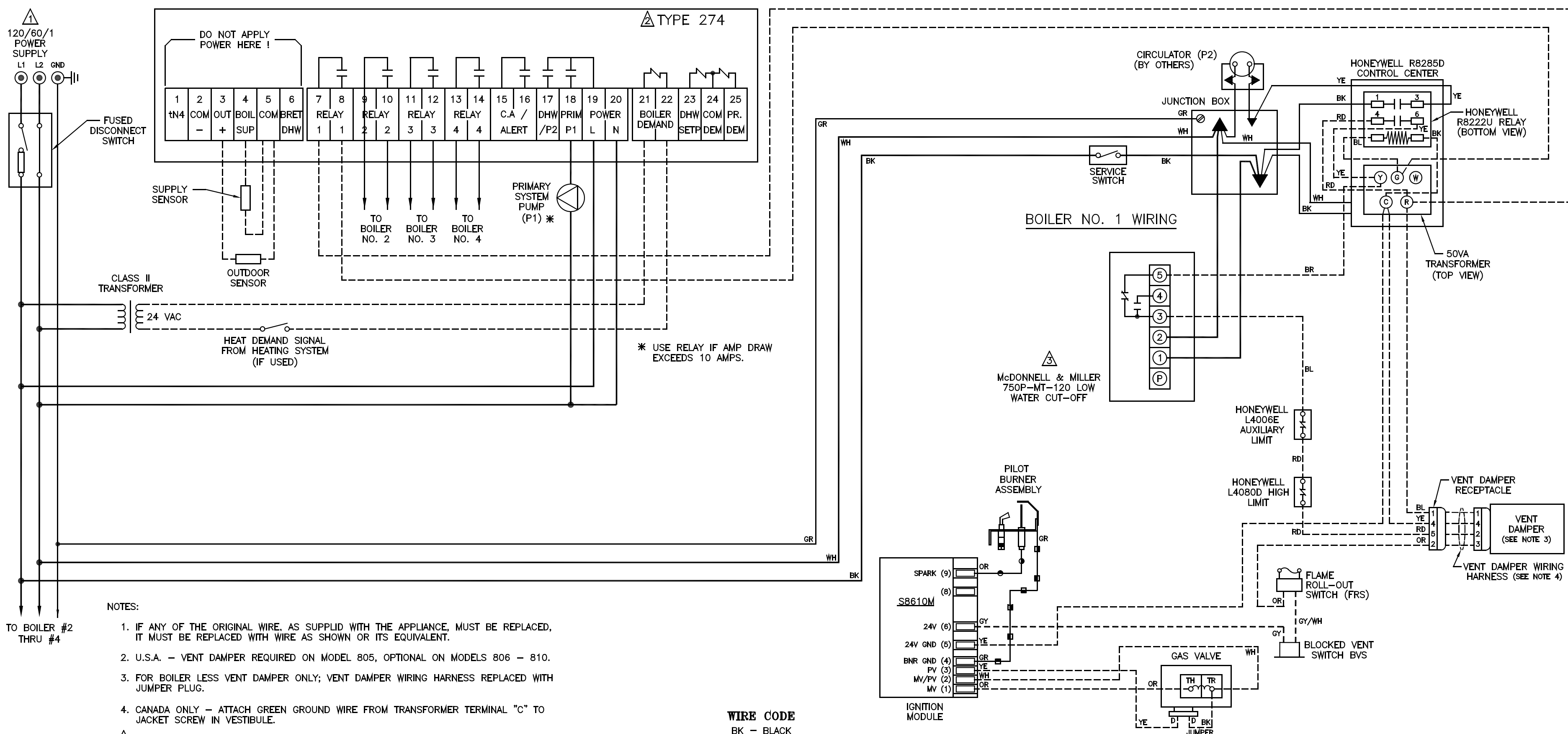
- LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C
- LOW VOLTAGE SIZE 18/2 AWG TYPE CL2X STRANDED WIRE – 105 C
- LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE SIZE 18 AWG TYPE TW OR TEW/AWM WIRE
- HONEYWELL IGNITER/SENSOR CABLE – 250 C
- GROUND – SIZE 18 AWG TYPE SF-2/SEW-2, STRANDED WIRE, $\frac{1}{32}$" THK INSULATION – 200 C

WIRE CODE

BK – BLACK
BL – BLUE
BR – BROWN
GR – GREEN
GY – GRAY
GY/WH – GRAY WITH WHITE TRACE
OR – ORANGE
RD – RED
WH – WHITE
YE – YELLOW

TEKMAR 274, FOUR-STAGE, EI, FOR PARALLEL PIPING

FIGURE 5-5



NOTES:

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLID WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805, OPTIONAL ON MODELS 806 – 810.
3. FOR BOILER LESS VENT DAMPER ONLY; VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.
4. CANADA ONLY – ATTACH GREEN GROUND WIRE FROM TRANSFORMER TERMINAL "C" TO JACKET SCREW IN VESTIBULE.

⚠1 POWER SUPPLY – PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 SEE TEKMAR A274 BROCHURE PACKED WITH CONTROL FOR DIP SWITCH SETTINGS.

⚠3 M&M NO. 750P–MT LOW WATER CUT–OFF IS STANDARD ON 808, 809 AND 810.

SCHEMATIC DIAGRAM LEGEND

- LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C
- LOW VOLTAGE SIZE 18/2 AWG TYPE CL2X STRANDED WIRE – 105 C
- LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE SIZE 18 AWG TYPE TW OR TEW/AWM WIRE
- HONEYWELL IGNITER/SENSOR CABLE – 250 C
- GROUND – SIZE 18 AWG TYPE SF–2/SEW–2, STRANDED WIRE, $\frac{1}{32}$" THK INSULATION – 200 C

WIRE CODE

BK – BLACK
BL – BLUE
BR – BROWN
GR – GREEN
GY – GRAY
GY/WH – GRAY WITH WHITE TRACE
OR – ORANGE
RD – RED
WH – WHITE
YE – YELLOW

TEKMAR 274, FOUR-STAGE, EI, FOR PRIMARY SECONDARY PIPING

FIGURE 5-6

NOTES :

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805B, OPTIONAL ON MODELS 806B – 810B.
3. FOR BOILER LESS VENT DAMPER ONLY: VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.

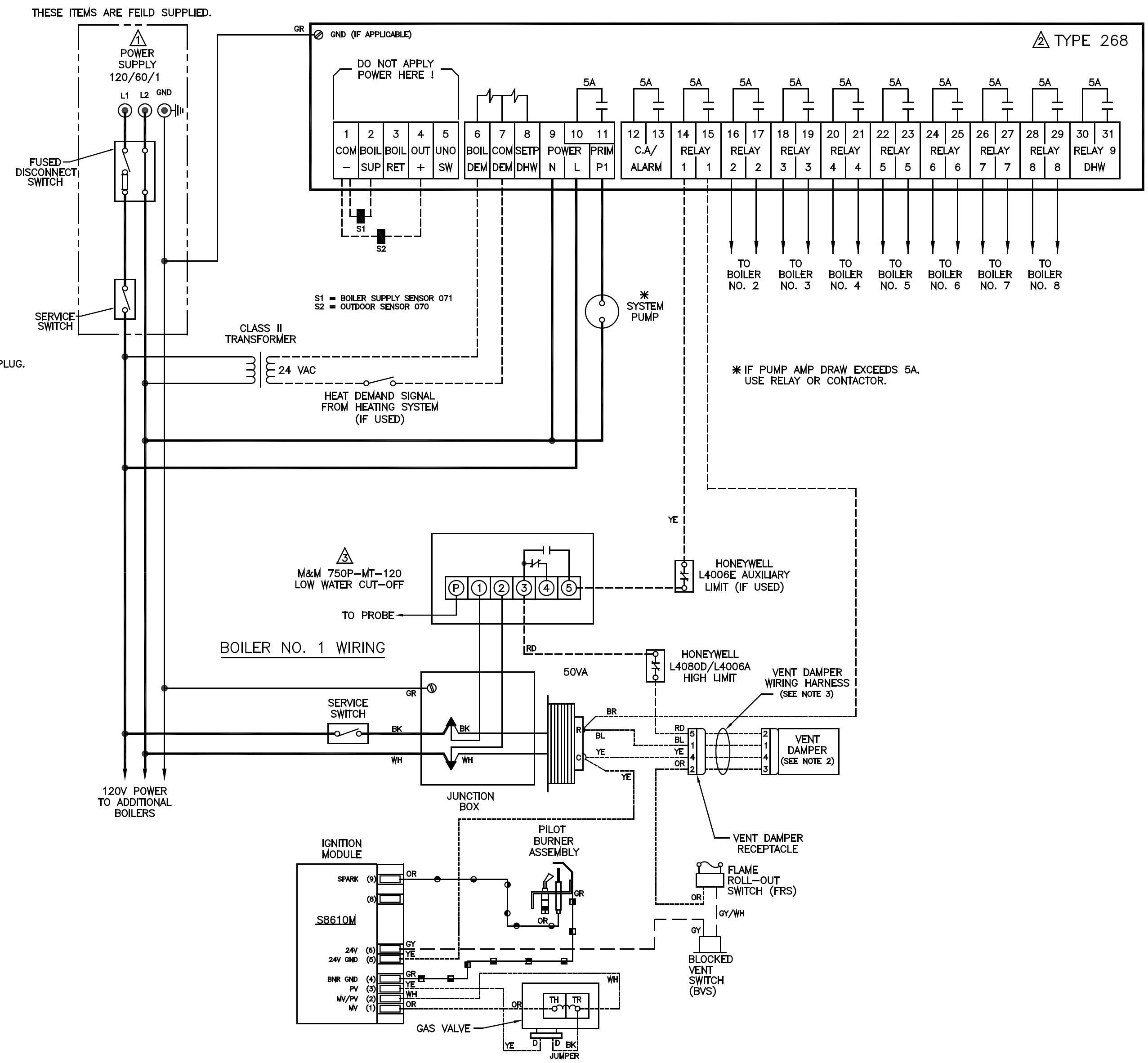
⚠1 POWER SUPPLY, PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 SEE TEKMAR D268 BROCHURE PACKED WITH CONTROL FOR CONTROL SETTINGS.

——— LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE

– – – – LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C

——— 120V – 18 AWG WIRE TYPE TEW/AWM 105 C WITH 31 MIL THICK INSULATION



TEKMAR 268, EIGHT-STAGE, EI, FOR PARALLEL PIPING

FIGURE 5-7

NOTES :

1. IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH WIRE AS SHOWN OR ITS EQUIVALENT.
2. U.S.A. – VENT DAMPER REQUIRED ON MODEL 805B, OPTIONAL ON MODELS 806B – 810B.
3. FOR BOILER LESS VENT DAMPER ONLY: VENT DAMPER WIRING HARNESS REPLACED WITH JUMPER PLUG.

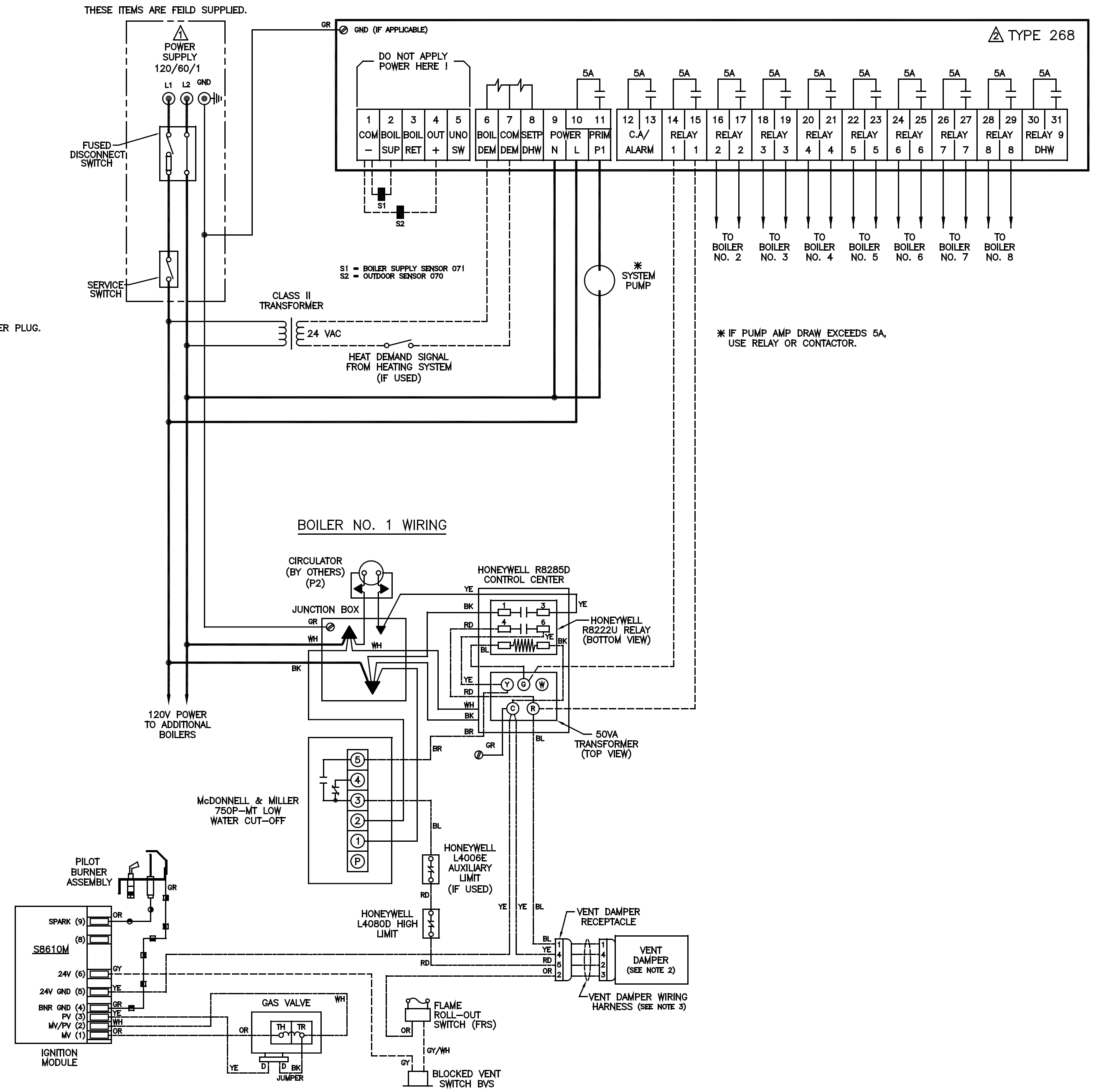
⚠1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 SEE TEKMAR D268 BROCHURE PACKED WITH CONTROL FOR CONTROL SETTINGS.

——— LINE VOLTAGE SIZE 14 AWG TYPE TW OR TEW/AWM WIRE

- - - - LOW VOLTAGE SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE – 105 C

——— 120V – 18 AWG WIRE TYPE TEW/AWM 105 C WITH 31 MIL THICK INSULATION



TEKMAR 268, EIGHT-STAGE, EI, FOR PRIMARY SECONDARY PIPING

FIGURE 5-8

SECTION 6.0
START-UP AND SERVICE

⚠WARNING

Service on this boiler should be undertaken only by trained and skilled personnel from a qualified service agency. Inspections should be performed at intervals specified in this manual. Maintain manual in a legible condition.

Keep boiler area clear and free of combustible materials, gasoline and other flammable vapors and liquids.

Do not place any obstructions in boiler room that will hinder flow of combustion and ventilation air.

The service instructions contained in this manual are in addition to the instructions provided by the manufacturer of the boiler components. Follow component manufacturer's instructions. Component manufacturer's instructions were provided with the boiler. Contact component manufacturer for replacement if instructions are missing. Do not install, start up, operate, maintain or service this boiler without reading and understanding all of the component instructions. Do not allow the boiler to operate with altered, disconnected or jumpered components. Only use rePLACEMENT COMPONENTS IDENTICAL TO THOSE ORIGINALLY SUPPLIED BY BURNHAM COMMERCIAL.

⚠WARNING

Completely read, understand and follow all instructions in this manual before attempting start-up.

WARNING - BEFORE INSTALLATION OF THE BOILER IS CONSIDERED COMPLETE THE OPERATION OF THE BOILER CONTROLS SHOULD ALL BE CHECKED, PARTICULARLY THE LOW WATER CUT-OFF AND THE HIGH LIMIT CONTROLS.

6.1 FILL ENTIRE HEATING SYSTEM WITH WATER and vent air from system. Use the following procedure on a system equipped with zone valves.

1) Close all but one zone valve.
2) Open drain valves on boilers.
3) Open fill valve.
4) Close purge valve.
5) Open relief valves on boilers.
6) Allow water to run out of drain valve until zone has been purged of air and filled with water.
7) Open zone valve to the second zone to be purged, then close the first. Repeat this step until all zones have been purged but always have one zone open. At completion open all zone valves.
8) Close drain valve.
9) When water discharges from relief valves, release the lever on the top of the relief valves, allowing them to close.
10) Continue filling the system until the pressure gauge reads 12 psi. Close fill valve.
11) Open purge valve.
12) Start system circulator.

⚠WARNING

The maximum operating pressure of this boiler is 50 psig. Never exceed this pressure. Do not plug or modify pressure relief valve.

6.2 TEST GAS PIPING. Test main and pilot gas piping at boiler for leaks at all piping connections and valves. Refer to 4.5.6.

6.3 PURGE GAS PIPING OF AIR

1) Disconnect electric service to boiler.
2) Turn control knob on all modules' combination gas valves to off position.
3) Open valve on main gas line at meter.
4) Starting with Module #1 disconnect pilot tubing from outlet side of combination gas valve. Depress Control Knob slightly and turn to "Pilot" position. Depress Knob fully and hold until gas issues from disconnected fitting. Release Knob and reconnect pilot tubing. Turn control knob to off.
5) Repeat (4) for each module in sequence.

6.4 Make sure that pilot tubing has been reconnected. Wait five minutes then proceed "To Light" in accordance with boiler operating instructions attached to the boiler jacket. On boilers equipped with standing pilots, light the pilot of each boiler in sequence.

6.5 CHECK GAS INPUT rate to each boiler separately. Input rate must not exceed that shown on Rating Plate. For propane gas adjust regulator for a burner manifold pressure of eleven (11.0) inches water column.

For natural gas, check input rate shown on boiler rating plate as follows:

1) Consult local gas company for heating value of gas (BTU/Cu. Ft.).
2) Set limit and operating control high enough so boiler will not shut off while checking input rate.
3) All other gas burning appliances served by meter should be turned off temporarily while checking input rate.
4) Check manifold pressure at 1/8" tapping on burner manifold. Pressure should be approximately 3½" water column for natural gas. Adjustment of gas pressure can be made by turning regulator

adjusting screw counterclockwise to decrease manifold pressure (gas rate) or clockwise to increase. Adjustment of Regulator must be within limitations set forth by Gas Supplier.

If necessary to increase or decrease manifold pressure more than 0.3" water for natural gas to provide rated input, remove orifice plugs installed in burner manifold and:

a) Increase orifices one (1) drill size larger to reduce manifold pressure to that recommended, or

b) Replace orifices with one (1) drill size smaller to raise manifold pressure to that recommended.

c) Reinstall orifice plugs and recheck input rate.

5) After adjusting manifold pressure to that recommended, make a final check on input by clocking the gas meter. Only the gas boiler should be in operation (make sure that all other gas appliances connected to the same meter are not operating). Check the gas consumption indicated by the gas meter for three minutes for conformity to that required and as determined by the following formula:

Gas Input, Cu. Ft. per 3 minutes =

(Input, Btu/hr.

(Heating Value of gas, Btu/Cu. Ft.) x 20

NOTE: In the above formula, (Input, Btu/hr.) is that shown on the Boiler rating plate, and heating value of gas, Btu/Cu. Ft., must be obtained from the local gas company.

I.E. Input for 5-Section Boiler is 264,000 Btu/hr.
Heating value of gas is 1,000 Btu/cu. ft.
Therefore: $\frac{264{,}000}{1{,}000 \times 20} = \frac{264{,}000}{20{,}000} = 13.2$ cu. ft./3 min.

6) Return all control settings to their normal positions.

6.6 ADJUST AIR SHUTTERS on Main Burners by loosening shutter lock screw and closing them until yellow tips appear on flames, then open shutters slowly until clearly defined inner cones may be seen. Tighten screws to hold the air shutters in this position.

6.7 SEQUENCE OF CONTROLS

See Section 5.0 for the sequence of controls that applies to the system installed.

⚠WARNING

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

6.8 CLEANING BOILER FLUES AND BURNERS

Boiler flues should be inspected annually and burners should be cleaned annually. The proper procedures for this maintenance, including removal and reinstallation of canopy, burners, and pilot assemblies, are detailed and diagrammed in the "INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS" manual supplied with each 8H/8HE Series Boiler.

For service or repairs to boiler, call our heating contractor. When seeking information on boiler, provide Boiler, provide Boiler Model Number and Serial Number as shown on Rating Label.

Boiler Model Number	Boiler Serial Number
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _
_8_ _ _ _ _ - ____	6_ _ _ _ _ _ _

Heating Contractor	Installation Date
Address	Phone Number

IX. Repair Parts

All Series 8H/8HE repair parts may be obtained through your local Burnham Wholesale Distributor. Should you require assistance in locating a Burnham Distributor in your area, or have questions regarding the availability of Burnham products or repair parts, please contact Burnham Customer Service at (717) 481-8400 or Fax (717) 481-8408.

Limited Warranty

For Commercial Grade Boilers

Using Cast Iron, Carbon Steel, or Stainless Steel Heat Exchangers

and Parts / Accessories

Subject to the terms and conditions set forth below, Burnham Commercial, Lancaster, Pennsylvania hereby extends the following limited warranties to the original owner of a commercial grade water or steam boiler or Burnham Commercial supplied parts and/or accessories manufactured and shipped on or after October 1, 2009:

ONE YEAR LIMITED WARRANTY ON COMMERCIAL GRADE BOILERS AND PARTS / ACCESSORIES SUPPLIED BY BURNHAM COMMERCIAL.
Burnham Commercial warrants to the original owner that its commercial grade water and steam boilers and parts/accessories comply at the time of manufacture with recognized hydronic industry standards and requirements then in effect and will be free of defects in material and workmanship under normal usage for a period of one year from the date of original installation. If any part of a commercial grade boiler or any part or accessory provided by Burnham Commercial is found to be defective in material or workmanship during this one year period, Burnham Commercial will, at its option, repair or replace the defective part (not including labor).

HEAT EXCHANGER WARRANTIES
Burnham Commercial warrants to the original owner that the heat exchanger of its commercial grade boilers will remain free from defects in material and workmanship under normal usage for the time period specified in the chart below to the original owner at the original place of installation. If a claim is made under this warranty during the "No Charge" period from the date of original installation, Burnham Commercial will, at its option, repair or replace the heat exchanger (not including labor). If a claim is made under this warranty after the expiration of the "No Charge" period from the date of original installation, Burnham Commercial will, at its option and upon payment of the pro-rated service charge set forth below, repair or replace the heat exchanger. The service charge applicable to a heat exchanger warranty claim is based upon the number of years the heat exchanger has been in service and will be determined as a percentage of the retail price of the heat exchanger model involved at the time the warranty claim is made as follows:

	Service Charge as a % of Retail Price									
Years in Service	1	2	3	4	5	6	7	8	9	10+
Cast Iron	No Charge									100
Carbon Steel	No Charge	100								
Stainless Steel	No Charge					20	40	60	80	100

NOTE: If the heat exchanger involved is no longer available due to product obsolescence or redesign, the value used to establish the retail price will be the published price as set forth in Burnham Commercial Repair Parts Pricing where the heat exchanger last appeared or the current retail price of the then nearest equivalent heat exchanger, whichever is greater.

ADDITIONAL TERMS AND CONDITIONS

1. Applicability: The limited warranties set forth above are extended only to the original owner at the original place of installation within the United States and Canada. These warranties are applicable only to boilers, parts, or accessories designated as commercial grade by Burnham Commercial and installed and used exclusively for purposes of commercial space heating or domestic hot water generation through a heat exchanger (or a combination for such purposes) and do not apply to residential grade products or industrial uses.
2. Components Manufactured by Others: Upon expiration of the one year limited warranty on commercial grade boilers, all boiler components other than heat exchangers manufactured by others but furnished by Burnham Commercial (such as oil burner, circulator and controls) will be subject only to the manufacturer's warranty, if any.
3. Proper Installation: The warranties extended by Burnham Commercial are conditioned upon the installation of the commercial grade boiler, parts, and accessories in strict compliance with Burnham Commercial installation instructions. Burnham Commercial specifically disclaims liability of any kind caused by or relating to improper installation.
4. Proper Use and Maintenance: The warranties extended by Burnham Commercial conditioned upon the use of the commercial grade boiler, parts, and accessories for its intended purposes and its maintenance accordance with Burnham Commercial recommendations and hydronics industry standards. For proper installation, use, and maintenance, see all applicable sections of the Installation and Operating, and Service Instructions Manual furnished with the unit.
5. This warranty does not cover the following:
   a. Expenses for removal or reinstallation. The owner will be responsible for the cost of removing and reinstalling the alleged defective part or its replacement and all labor and material connected therewith, and transportation to and from Burnham Commercial.
   b. Components that are part of the heating system but were not furnished by Burnham Commercial as part of the commercial boiler.
   c. Improper burner adjustment, control settings, care or maintenance.
   d. This warranty cannot be considered as a guarantee of workmanship of an installer connected with the installation of the Burnham Commercial boiler, or as imposing on Burnham Commercial liability of any nature for unsatisfactory performance as a result of faulty workmanship in the installation, which liability is expressly disclaimed.
   e. Boilers, parts, or accessories installed outside the 48 contiguous United States, the State of Alaska and Canada.
   f. Damage to the boiler and/or property due to installation or operation of the boiler that is not in accordance with the boiler installation and operating instruction manual.
   g. Any damage or failure of the boiler resulting from hard water, scale buildup or corrosion the heat exchanger.
   h. Any damage caused by improper fuels, fuel additives or contaminated combustion air that may cause fireside corrosion and/or clogging of the burner or heat exchanger.
   i. Any damage resulting from combustion air contaminated with particulate which cause clogging of the burner or combustion chamber including but not limited to sheetrock or plasterboard particles, dirt, and dust particulate.
   j. Any damage, defects or malfunctions resulting from improper operation, maintenance, misuse, abuse, accident, negligence including but not limited to operation with insufficient water flow, improper water level, improper water chemistry, or damage from freezing.
   k. Any damage caused by water side clogging due to dirty systems or corrosion products from the system.
   l. Any damage resulting from natural disaster.
   m. Damage or malfunction due to the lack of required maintenance outlined in the Installation and Operating Manuals furnished with the unit.
6. Exclusive Remedy: Burnham Commercial obligation for any breach of these warranties is limited to the repair or replacement of its parts (not including labor) in accordance with the terms and conditions of these warranties.
7. Limitation of Damages: Under no circumstances shall Burnham Commercial be liable for incidental, indirect, special or consequential damages of any kind whatsoever under these warranties, including, but not limited to, injury or damage to persons or property and damages for loss of use, inconvenience or loss of time. Burnham Commercial liability under these warranties shall under no circumstances exceed the purchase price paid by the owner for the commercial grade boiler involved. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.
8. Limitation of Warranties: These warranties set forth the entire obligation of Burnham Commercial with respect to any defect in a commercial grade boiler, parts, or accessories and Burnham Commercial shall have no express obligations, responsibilities or liabilities of any kind whatsoever other than those set forth herein. These warranties are given in lieu of all other express warranties.

ALL APPLICABLE IMPLIED WARRANTIES, IF ANY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY LIMITED IN DURATION TO A PERIOD OF ONE YEAR EXCEPT THAT IMPLIED WARRANTIES, IF ANY, APPLICABLE TO THE HEAT EXCHANGER IN A COMMERCIAL GRADE BOILER SHALL EXTEND TO THE ORIGINAL OWNER FOR THE TIME SPECIFIED IN THE HEAT EXCHANGER SECTION SHOWN ABOVE AT THE ORIGINAL PLACE OF INSTALLATION. SOME STATES DO NOT ALLOW LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

PROCEDURE FOR OBTAINING WARRANTY SERVICE
In order to assure prompt warranty service, the owner is requested to complete and mail the Warranty Card provided with the product or register product online at www.burnhamcommercialcastiron.com within ten days after the installation of the boiler, although failure to comply with this request will not void the owner's rights under these warranties. Upon discovery of a condition believed to be related to a defect in material or workmanship covered by these warranties, the owner should notify the installer, who will in turn notify the distributor. If this action is not possible or does not produce a prompt response, the owner should write to Burnham Commercial, P.O. Box 3939, Lancaster, PA 17604, giving full particulars in support of the claim. The owner is required to make available for inspection by Burnham Commercial or its representative the parts claimed to be defective and, if requested by Burnham Commercial to ship these parts prepaid to Burnham Commercial at the above address for inspection or repair. In addition, the owner agrees to make all reasonable efforts to settle any disagreement arising in connection with a claim before resorting to legal remedies in the courts.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

BURNHAM®
Commercial Boilers

Burnham Commercial, P.O. Box 3939, Lancaster, PA 17604

Revised November 1, 2009

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